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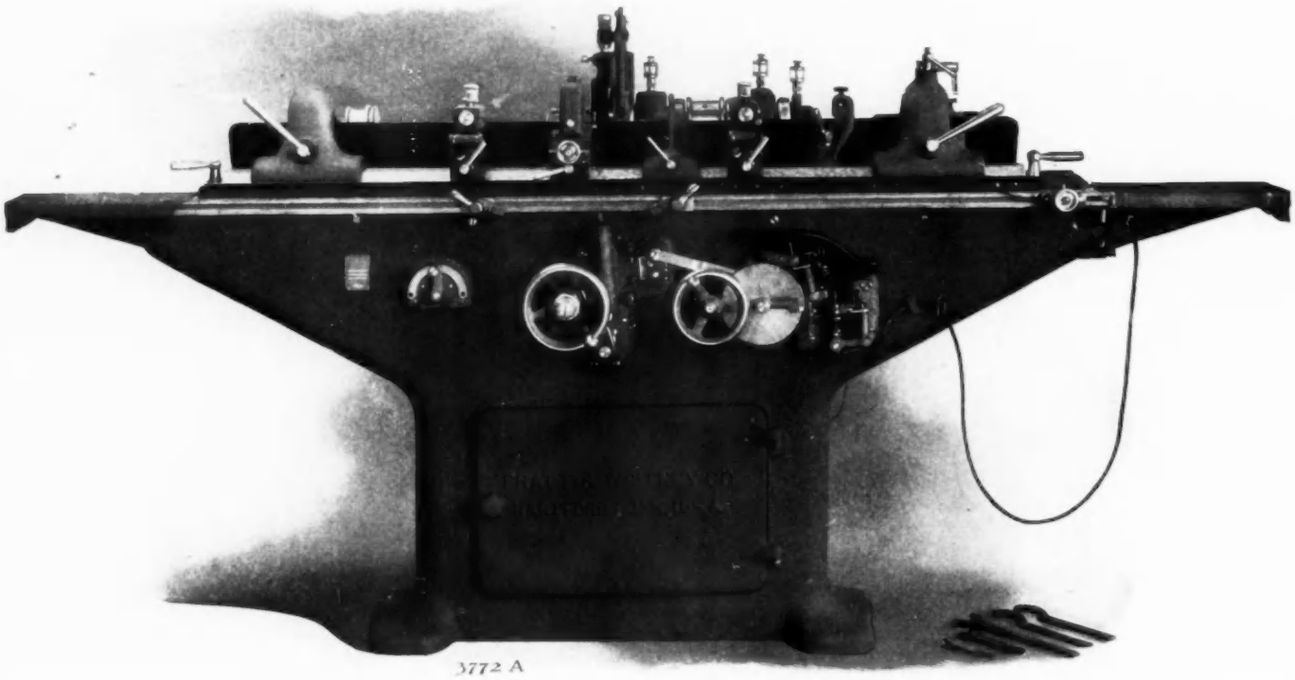

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Cincinnati High Power Milling Machines

A Series of Machines Built on the Unit System and a Striking Illustration of the Results Due to the Intelligent Use of That System

EDITORIAL CORRESPONDENCE

The milling machines described in the following article are the outgrowth of the conviction of the Cincinnati Milling Machine Company that the time has come for the entire re-design of milling machines for high power work, and of much study and experimental work undertaken in order to produce machines which, beginning with a given cut, should be harmoniously designed from the spindle back through the entire machine to the motor to produce that cut. This standard cut, which forms the starting point in the design of the machines, is (taking the No. 4 plain horizontal as an example) ⅜ inch deep by 6 inches wide, with such a rate of feed as will remove from 7 to 8 cubic inches of metal per minute—this cut being taken in machinery steel of 55,000 pounds, tensile strength, with a standard spiral milling cutter having nicked teeth. The machine is designed to take this cut for continuous service and to safely take a maximum cut considerably larger than the standard cut used as a basis.

Back of these convictions is the principle, strongly advocated by this company, that modern machine tools should not be sold on the old basis of net weight and driving-pulley dimensions, but on the basis of the quantity and quality of work they can produce. While these machines are thus in line with the progress toward high-power milling, the company recognizes that all milling is not of that class and they have no intention of discontinuing the production of the older type of machine.

The Unit System

Next to this feature lay the determination to produce a line of machines to meet the possible wants of a customer as regards his system of driving and feeding, and capable of being changed by him at any time to suit any change in his transmission system;—and to offer these machines in the same variety of driving and feeding arrangements with both vertical and horizontal spindles.

This latter result is nothing less than a remarkable achievement in machine design. It is brought about by the unit system of construction, whereby the simple selection of appropriate units produces the machine desired. The basis of the complete design is the constant speed belt-driven machine with the driving shaft parallel with the spindle, the feed box being driven from the constant speed shaft, and fitted with an index plate giving the feed in inches per minute. By simply removing a bracket and supplying another, this is converted into a machine of the same style, but having the driving shaft at right angles with the spindle. Again, by removing the driving-gear box and substituting another simpler one, the machine becomes a cone-pulley machine in which the feeds are driven from the spindle, but with no change in the feed box itself. Substituting a different feed index plate, however, gives the feeds in thousandths per revolution. By the same exchange of brackets as before, this cone-pulley machine becomes one with the driving shaft parallel with, or at right angles to, the spindle, as desired. By substituting a sprocket wheel for the driving pulley and adding a bracket at the base, the constant speed belt machine becomes a constant speed motor-driven machine and by a similar substitution the cone pulley machine becomes a variable speed motor-driven machine, the feed being appropriate to the drive in all cases.

Vertical Spindle Machines

Even more noteworthy is the application of the same system to machines having vertical spindles, for up to the frame head the horizontal and vertical spindle machines are identical, the vertical machine involving nothing not contained in the horizontal machine except the frame casting, the mechanism at its top, and a pair of bevel gears to change the motion of the horizontal shaft to the vertical shaft. In this way no less than 12 distinct machines are made by merely changing the frame and drive, the table mechanism and feed box being identical in all types, while there are but two speed boxes.

The flexibility of arrangement is clearly shown in Figs. 1 to 6, of which Figs. 1 and 2 show the constant speed drive with inches per minute feed, and the parallel and right-angle arrangements of driving pulley respectively. Figs. 3 and 4 show the cone-pulley drive with thousandths per revolution feed, and the driving shaft parallel with and at right angles to the main spindle respectively, while Figs. 5 and 6 show the constant and variable speed motor drives, each with its appropriate feed system. Further flexibility in the style of feed arrangement is obtained by giving an option in the choice of either, feeds in inches per minute, or, feeds in thousandths per revolution, on all constant speed belt or motor-driven machines.

Fig. 7 shows the location of the motor and Fig. 8 is a rear view of the constant speed drive machine, while Fig. 9 is a larger view showing the operator's position and the convenience of the adjustments.

The Constant Speed Drive

Taking up first the constant speed drive arrangement, it is well shown in Figs. 10 to 14. Of these Fig. 10 shows the upper part of the column of the machine with a cover plate located on the opposite side of the column from the gear box removed. At the left will be seen the back gears and immediately at the right of the back-gear pinion on the main spindle, a pinion of the same pitch but of narrower face whose only office is to facilitate engagement of the teeth, as will be explained later, and at the right of this, two sliding gears which are mounted on a quill which is slid endwise by an external lever. Below this, is the cone of gears with two of which the sliding gears just mentioned also engage and behind which, as seen in this picture, is located the tumbler gear shown, with the remainder of the interior of the gear box, in Fig. 11. Fig. 12 shows the outside of the gear box with the operating levers and pilot wheel and the index plate.

The entire transmission train is shown in section in Fig. 13. The main driving pulley is mounted on the bracket *a* attached to the machine frame. It transmits power to the main driving shaft *b* through the friction clutch shown, which is operated by the lever at the front of the machine, as shown in the general views and at the right of Fig. 12. When this clutch is disengaged, the pulley runs free on the bracket and is the only part of the machine that turns over, making it entirely practicable to drive the machine from the main-line shaft without the use of an intervening countershaft. Moreover, the strain due to the pull of the main driving belt does not come on the shaft at all, but on the sleeve *a*, thus relieving the shaft entirely of bending strains.

Suppose the pulley clutched to the shaft: Power is transmitted to the tumbler gears *c c*, which may be brought into mesh with any one of the cone gears *d*, thence through the sliding gear *e*, the long quill *g* and the back gears *h i j k*, which provides four different speeds. If the sliding gear *f* is brought into mesh with the cone gear, a different series of four speeds is provided. Again, if the back gears are slid out of engagement and the clutch teeth *l* are engaged, transmission is direct through any one of the

four cone gears and the sliding gears, thus giving two additional series of four speeds each, making a total of sixteen different spindle speeds, the eight fastest of which are obtained with only two pairs of gears in mesh, the eight slowest requiring four pairs of gears in mesh.

with it. The entire combination of sliding gears and sleeve *g* runs free on the spindle. The large gear *k* is keyed to the spindle and is always the point of application of power to the spindle, the transmission being through the above mentioned sleeve, thus relieving the spindle

The sliding gears are operated by the lever shown in Fig. 12, which takes the positions *C* and *D* while the back gears and the clutch pinion are moved by the lever which takes the positions *A* and *B*. The lever has a large arc of motion which, combined with an eccentric con-

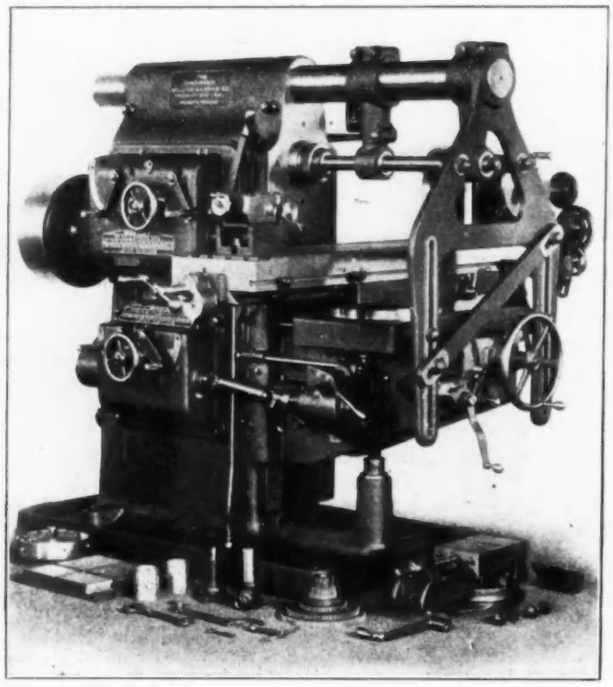


FIG. 1. PARALLEL DRIVE

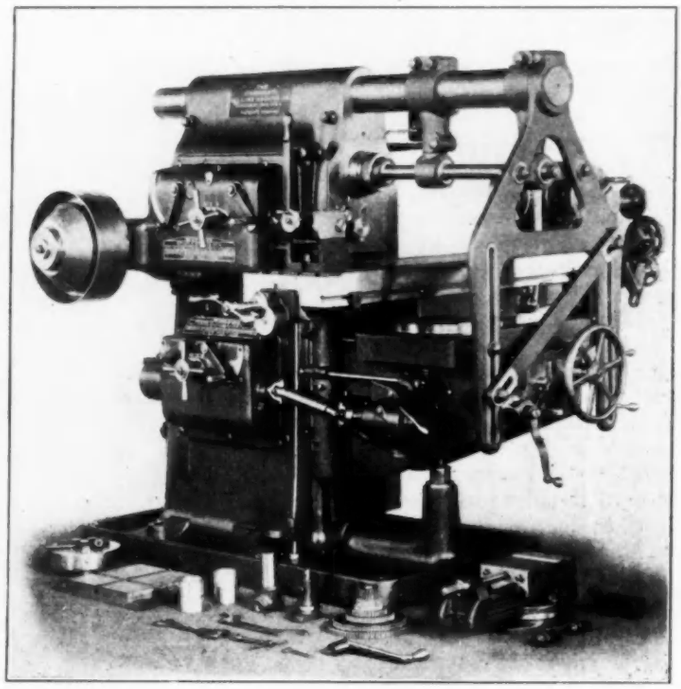


FIG. 2. RIGHT-ANGLE DRIVE

CONSTANT-SPEED DRIVEN MACHINES, INCHES PER MINUTE FEED

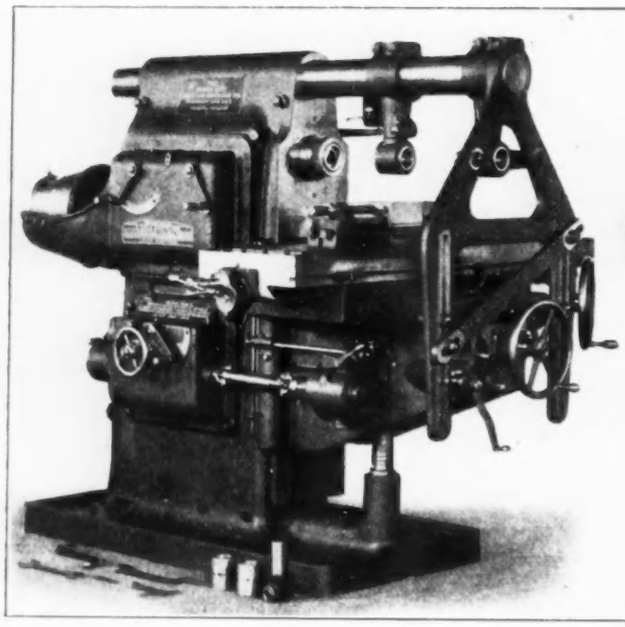


FIG. 3. PARALLEL DRIVE

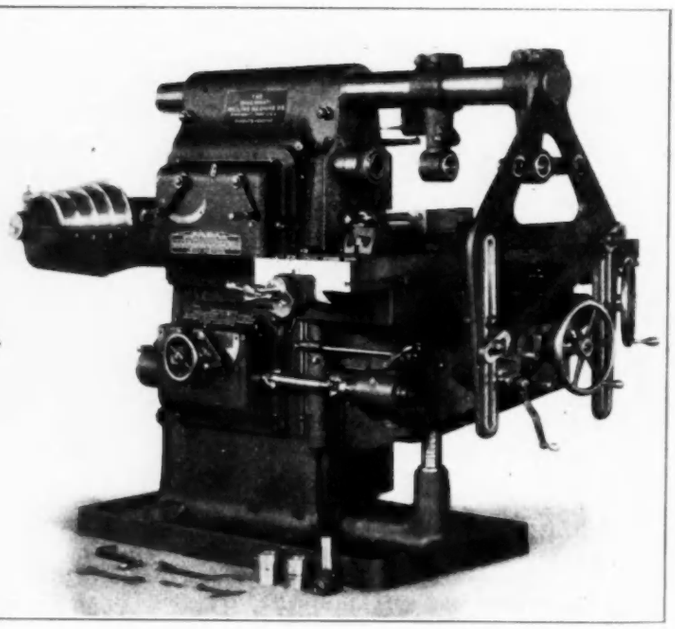


FIG. 4. RIGHT-ANGLE DRIVE

CONE-PULLEY DRIVEN MACHINES, THOUSANDTHS PER REVOLUTION FEED

The Spindle Relieved of Strain

There are a number of novel features in this construction. It will be noted that the sleeve *g* has keyed to it the small gear *m*, and the sliding gears *e* and *f* are keyed to the sleeve *g*, and always revolve at all times of torsional strains throughout its length with correspondingly reduced liability to chatter. Another feature of the mechanism is that no gears are ever in engagement except those used for transmission.

struction, permits the heavy parts to be moved with very little effort. Gear *m*, Fig. 13, is the one already referred to in connection with Fig. 10 as being provided to facilitate engagement. It is formed a part of pinion *h*, having the same number of

teeth. Assuming that the clutch teeth *l* are in engagement and the operator wishes to change to slower speeds through the back gears, the lever is moved to the *A* position, Fig. 12. The first part of its motion will cause a disengagement of the clutch teeth *l*. Meanwhile pinion *j* is not yet in engagement with *k*, and therefore does not revolve. The clutch being out of engagement, the face gear is also idle, and it might therefore happen that the teeth of *j* would not come opposite the spaces in the gear *k*, in which case it would be impossible to bring these two gears into engagement, but *m* prevents such a possibility. It enters into engagement with *i* before the clutch is entirely disengaged, and thus revolves *i* and *j* before the latter comes into engagement with *k*.

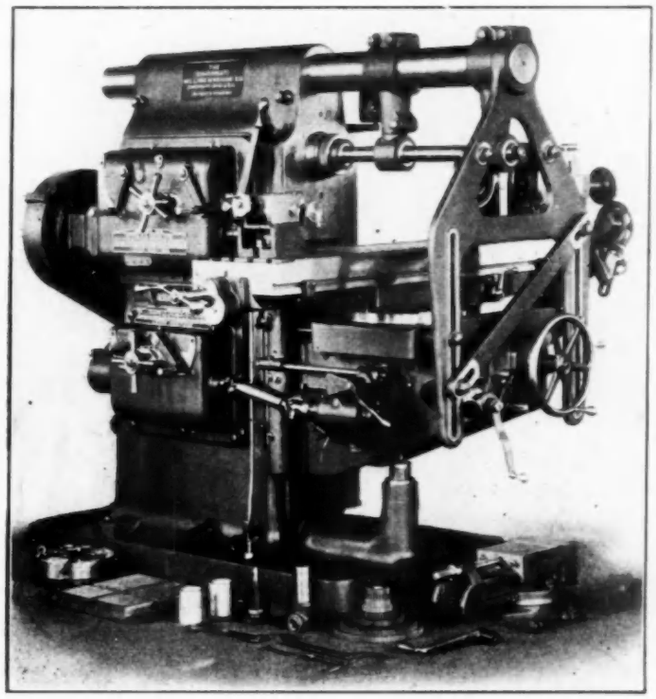


FIG. 5. CONSTANT-SPEED MOTOR

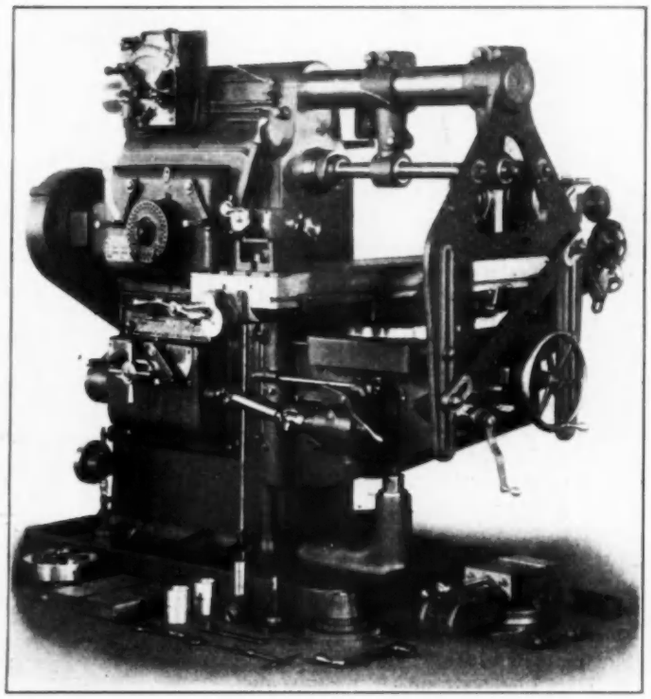


FIG. 6. VARIABLE-SPEED MOTOR

MOTOR-DRIVEN MACHINES

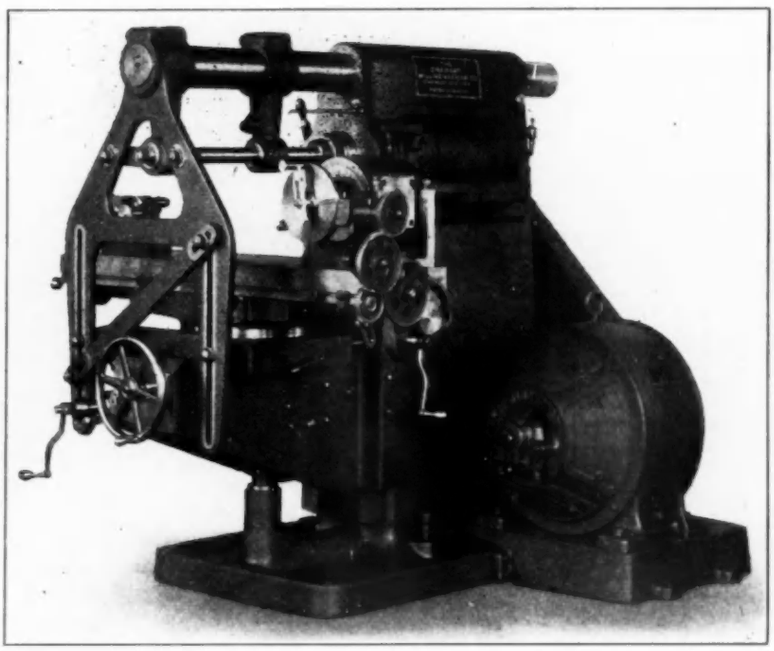


FIG. 7. MOTOR-DRIVEN MACHINE, SHOWING POSITION OF MOTOR

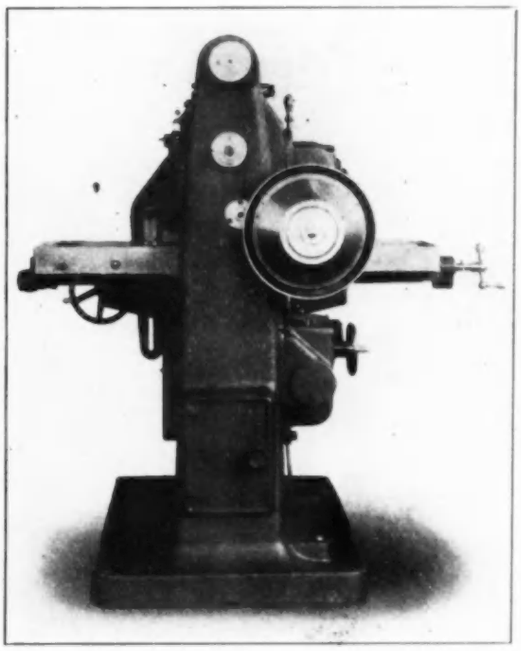


FIG. 8. REAR VIEW OF CONSTANT-SPEED DRIVEN MACHINE

Driving Shafts Relieved of Strain

The intermediate or back-gear shaft is fixed stationary, the cone gears and the back gears running freely on it. It is, therefore, never subjected to torsional strains, but only to bending strains due to the thrust of the gear teeth, from which it will be seen that neither the driving shaft *b*, the back-gear shaft, nor the spindle throughout its length are at any time subjected to both bending and torsional strains, thus greatly increasing the rigidity of these parts as transmission members.

The tumbler gears *c c* are mounted in a large frame, which is carried on a slide

in the drive box. The construction and operation will be clear from Fig. 14. The tumbler is operated by means of the pilot wheel on the outside of the box, Figs. 12 and 14, its four positions being indicated by the numerals 1 — 2 — 3 — 4, Fig. 12. The gears *c c* are carried in a rocking yoke, which is trunnioned in the main tumbler frame, which on one of its trunnions carries the segment of a spiral gear *o*, and this engages with a spiral gear *p*, carried on the end of the pilot-wheel shaft. If the pilot wheel is turned to the left, the swinging yoke carrying the tumbler gears is revolved by the spiral gears, and is thus raised clear of the cone gears. The entire tumbler mechanism may then be moved laterally to the desired position, where it is properly located by a detent pin.

The Tumbler Locked in Position

Then, by turning the pilot wheel to the right the tumbler gears are brought into mesh with the proper cone gear, the depth of their meshing being determined by the stop pin *n*, against which a lug of the rocking yoke abuts. If, after these parts have been brought home, additional pressure is put on the pilot wheel, it serves to act through the spiral gears, and the swinging yoke, forming a combination of screw and levers, which locks the main tumbler frame to its slide. The tooth angle of the spiral gears is smaller than the friction angle of the material from which they are made, thus making them self-locking.

From the above it will be clear that the entire weight of the tumbler and its parts is supported by its slide. The main driving shaft has clearance through the tumbler and is, therefore, not subjected to the weight of these parts, nor does it get any of the strains resulting from the locking feature. This positive locking of the tumbler is regarded as new and as a marked advantage, and even a necessity for the heavy power to be dealt with in the driving mechanism.

Reading the Index Plate

The spindle speeds are indexed on a plate located immediately below the speed-change levers, Figs. 12 and 15.

Suppose we wish to know the revolutions of the spindle with the levers set as in Fig. 12. The lever positions are

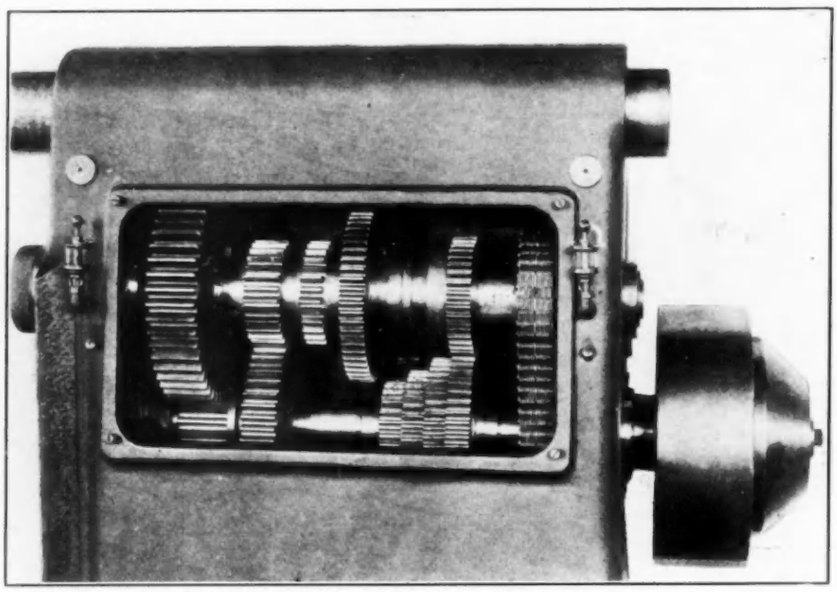


FIG. 10. UPPER PART OF COLUMN WITH COVER-PLATE REMOVED SHOWING DRIVING-GEAR TRAIN

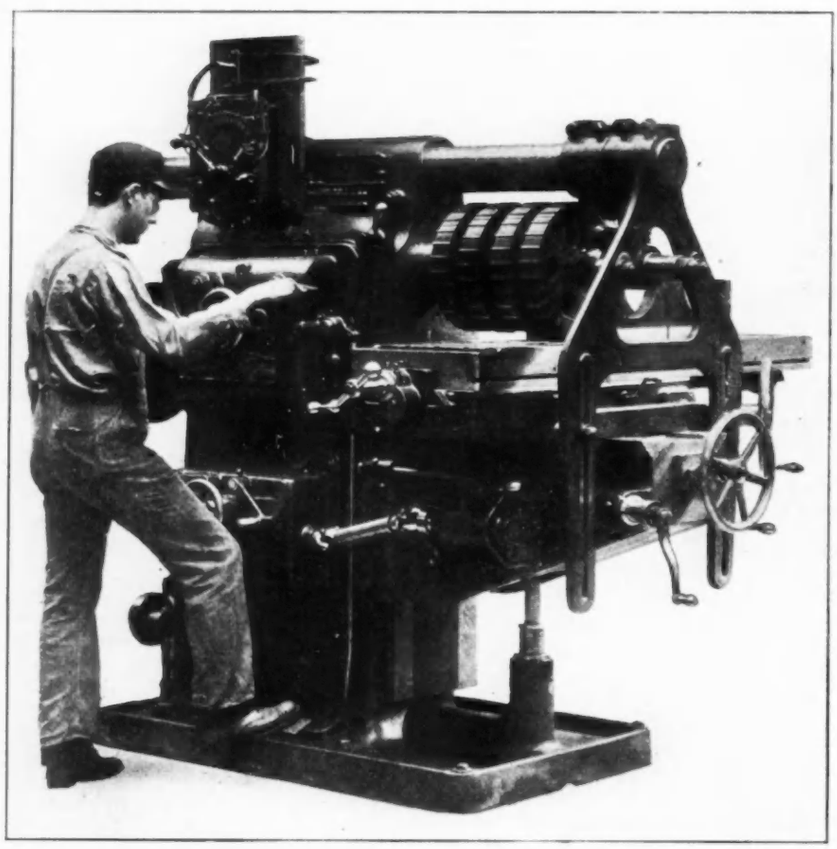


FIG. 9. VIEW SHOWING OPERATOR'S POSITION AND CONVENIENCE OF ADJUSTMENTS

3-*B C*. Referring to the index plate, Fig. 15, this corresponds with 115 revolutions per minute—the speed of the spindle. Suppose next we wish to set the speed for 21 revolutions. A glance at the index shows that the lever positions must be 3-*A C*—indications that would seem to be the limit of simplicity.

The Starting Treadle

Should the gears interfere when shifting the levers, they may be revolved slightly by exerting a gentle pressure on the treadle, shown in the illustrations of the complete machines, which is connected to the main starting lever. Pressure on the treadle moves the main clutch still farther out of its engagement position, and brings into contact the surface of the disk *q* which is attached to the driving shaft, and the surface of the flange *r*, Fig. 13, which is attached to the driving pulley. Thus it will be seen that by pressing on the treadle, sufficient friction can be obtained through these surfaces to slowly turn the gears over in case they interfere, and thus allow the lever to be set to the desired position in a few seconds.

The Spindle Lock

When attaching or removing arbors or, more especially, face mills which screw on the nose of the spindle, it is always desirable to lock the spindle. All of these

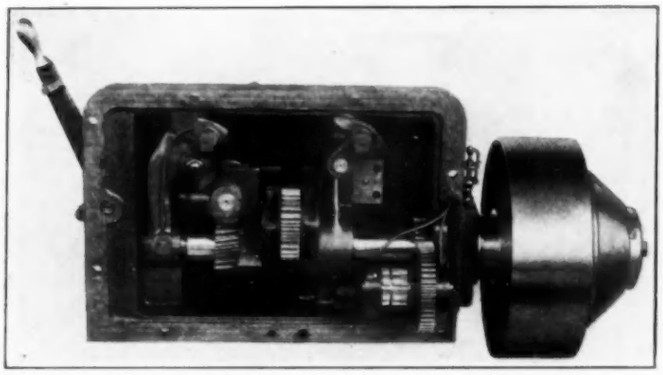


FIG. 11. INSIDE DRIVING-GEAR BOX

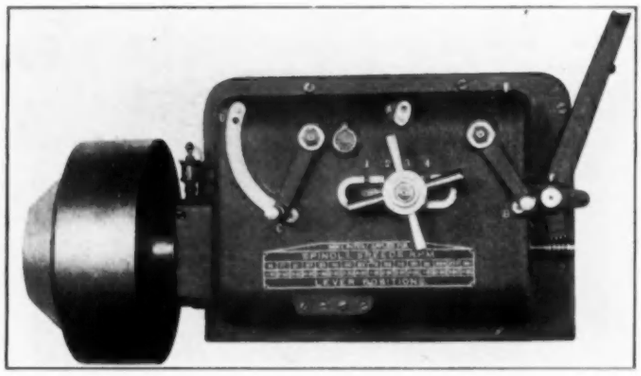


FIG. 12. OUTSIDE

machines are provided with a locking pin which engages ribs on the face-gear web, and these members, instead of the gears themselves, constitute the lock. The locking pin is controlled by the plunger seen immediately under the starting lever, Fig. 7. When this pin is pulled out the spindle is locked. When the machine is started, the first movement of the starting lever pushes the plunger in, releasing the lock before the driving clutch can come into engagement, and at the final position of the lever the plunger remains beneath it and the lock is held open. Thus it will be seen that this lock is automatically released, making accidents impossible.

The Cone-pulley Drive

The interior of the cone-drive box is shown in Fig. 16, the exterior being shown in Figs. 3 and 4. The two levers correspond exactly with the two similar levers on the constant speed drive box. When the machine is converted into a cone-driven miller two of the cone gears and all of the tumbler mechanism are omitted, the remainder of the machine being unchanged. One of the levers is used for operating the sliding gears to come in contact with the selective cone gears which remain, and the other lever operates the clutch on the spindle and simultaneously the two sliding back gears.

The four changes in speed which are obtained by the one, two, three, four positions of the tumbler on the constant speed drive arrangement, are obtained by shifting the belt to the one, two, three, four steps of the cone which are numbered to correspond with the indications of the index plate.

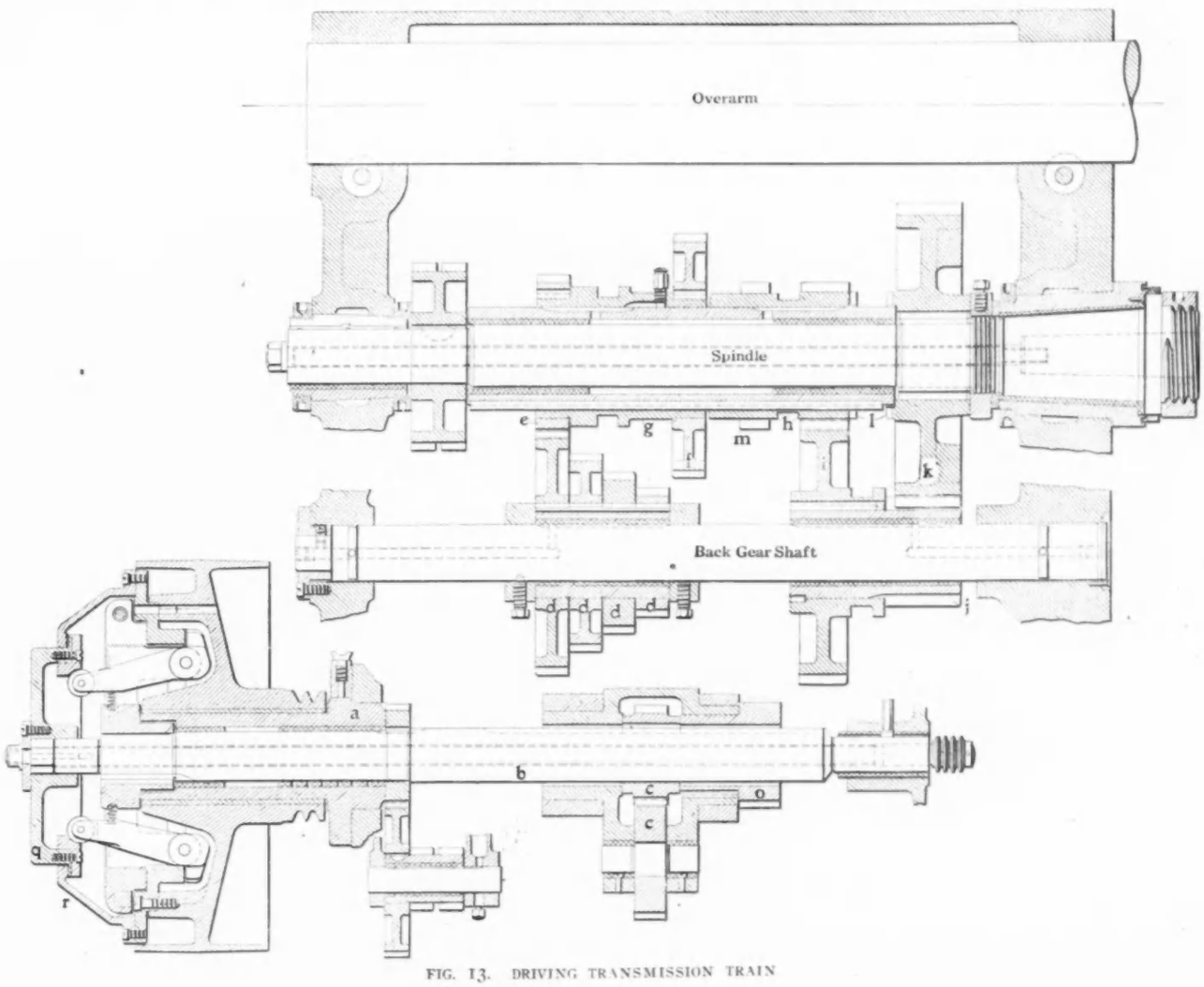


FIG. 13. DRIVING TRANSMISSION TRAIN

The Feed Gear Box

The outside and inside of the feed box are shown in Figs. 17 and 18 respectively, the location of this box being below that of the driving-gear box, as shown by the general illustrations. The feed mechanism, which provides a series of 16 feeds, is driven by a silent chain of two inches width on the No. 4 machine, either from the main driving shaft running at constant speed, in which case the feed plate reads in inches per minute, as shown in Fig. 19, or direct from the cutter spindle, in which case the feed plate reads in thousandths per revolution, as shown in Fig. 20, and in accordance with the older practice. The connection of the chain to the spindle for this system of driving is clearly shown in Fig. 10.

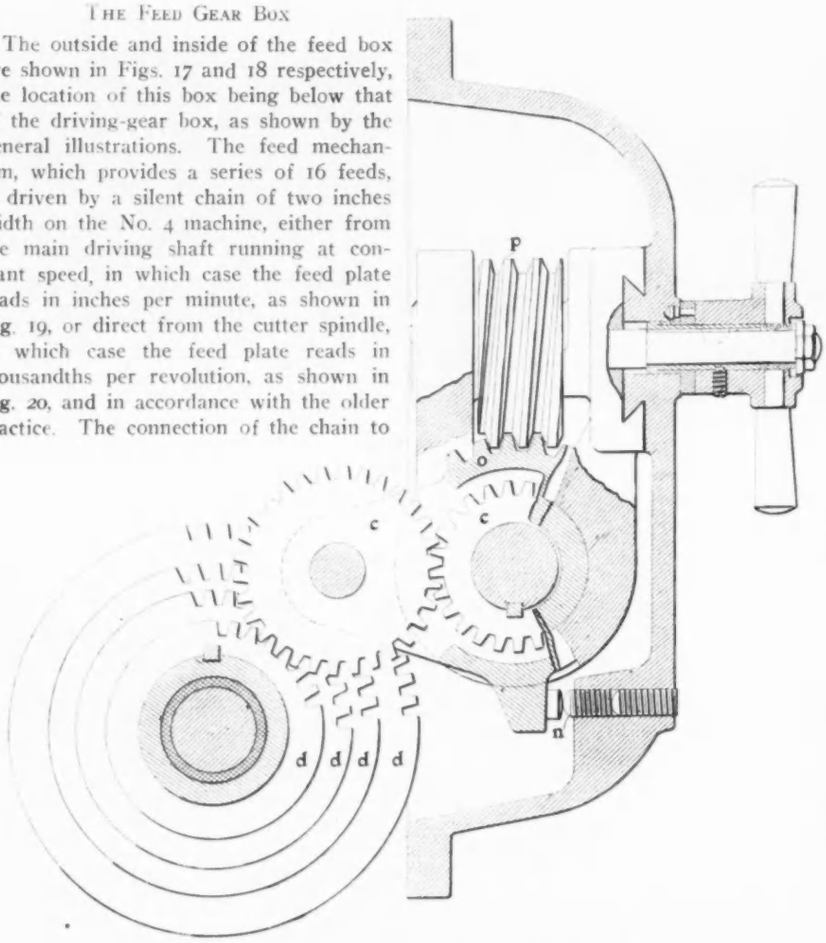


FIG. 14. TUMBLER GEARS AND FRAME

The construction of the feed box is essentially the same as that of the main spindle drive, and it is operated in exactly the same manner, except that the feed may be changed throughout the entire range while running. The clamping of the tumbler gear in position after adjusting is the same in both. The principal difference in the arrangement of the two gear boxes is that the driving-gear arrangement is reversed in the feed box; that is to say, the tumbler shaft, instead of being the first, is the last shaft—an arrangement which makes it possible to provide gears of large diameters running at moderate circumferential speeds, the result being to make it easy and safe to shift the gears while running.

The Feed Tripping and Reversing Box

The feed power is transmitted from the feed box through the universal-joint shaft to the feed tripping and reversing box, shown at the side of the knee in the general illustrations. This box also is assembled as a unit, its exterior and interior being shown in Figs. 21 and 22 respectively. Referring to Fig. 21, the ends of the two parallel shafts which run through the box will be seen. Gears on the universal-joint shaft drive the gears shown at the left of Fig. 22, the gear at the right being driven direct, and the one at the left through an idler pinion. A clutch between engages the gears at will with the shaft on which they run and thus determines the direction of rotation of the shaft, of the pinion at the extreme right and hence of the feeds. The location of this reversing clutch at the beginning of the feed mechanism makes it serve for both of the horizontal and also the vertical feeds. Moreover, the shaft upon which this tripping clutch is mounted runs at ten times the speed of the feed screw, and the pressure on the clutch teeth is thus reduced to 1/10 of that which would be required were the clutches mounted on the feed screw. This condition allows the clutch to be thrown out with great ease under the heaviest cuts, from which it follows that the trip is exceedingly sensitive and reliable.

The Feed Trip

The arrangement and properties of the feed-tripping mechanism are in the highest degree interesting and will be understood by reference to Fig. 23, which shows the knee and table in two views, partly in elevation and partly in section. The connection with the universal-joint shaft will be seen at *a*, while at *b* and *c* are the two gears already shown at the left of Fig. 22, with the reversing clutch *d* between them. At *e*, *f* and *g* respectively are the tripping plungers for the table lengthwise, crosswise and vertical

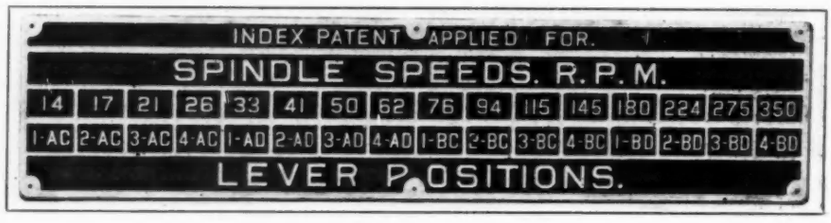

INDEX PATENT APPLIED FOR.
SPINDLE SPEEDS. R.P.M.
14 17 21 26 33 41 50 62 76 94 115 145 180 224 275 350
1-AC 2-AC 3-AC 4-AC 1-AD 2-AD 3-AD 4-AD 1-BC 2-BC 3-BC 4-BC 1-BD 2-BD 3-BD 4-BD
LEVER POSITIONS.

FIG. 15. SPINDLE-SPEED INDEX PLATE

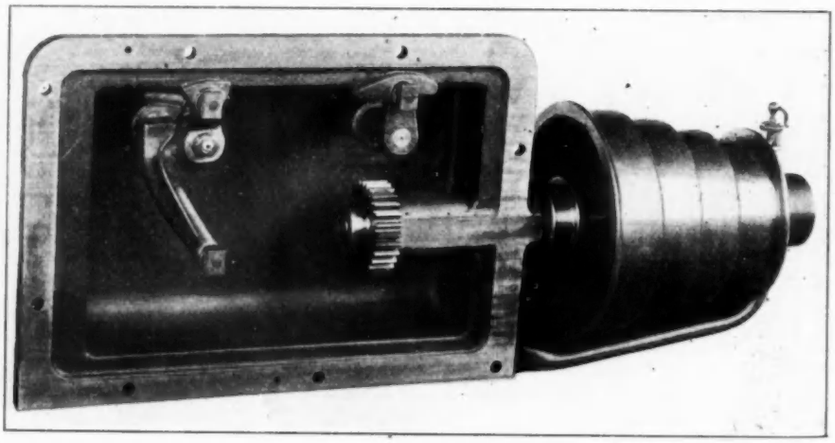


FIG. 16. INTERIOR OF CONE-DRIVE BOX

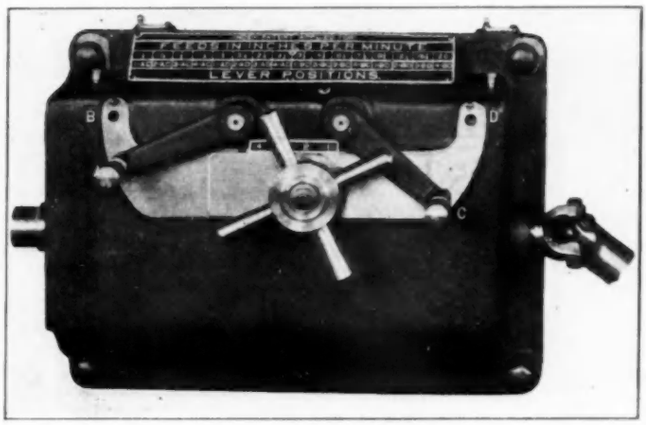


FIG. 17. OUTSIDE FEED-GEAR BOX

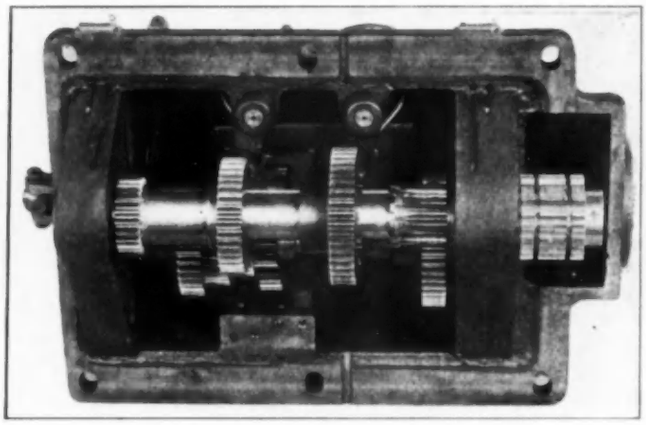


FIG. 18. INSIDE

feeds. Each one, it will be noted, has a circular rack at one end, all, either directly or indirectly, engaging the pinion *h*, which operates the tripping clutch *d*. In the case of the plunger *e* the connection with pinion *h* is through the long pinion *i*, which extends through the saddle and thus operates the secondary plunger *j*. The elongation of the pinion *i* is obviously to provide for the in and out movement of the saddle along the knee.

The neutral positions of the tripping plungers, which give the neutral position to the clutch *d*, are in all cases the middle; one extreme position of a plunger engaging the clutch in one direction and providing a feed in one direction, while the other extreme position gives the feed in the opposite direction. The heads of the plungers are double opposing cones, and each of the power feed movements is provided with two trip dogs; one of a length to operate on one cone surface while the other operates on the other; one dog serving to trip the feed for a movement in one direction, while the other operates in the opposite direction.

The Reversing Feed Mechanism

By removing the notched plunger *k*, which holds the clutch in the middle or neutral position, and substituting therefor a knife-edge plunger, and then slacking up the adjustable screws *ll* on the trip segment, the tripping mechanism becomes a reversing mechanism, the table feeding back and forth precisely like the table of a grinding machine, for example. This feature adapts the machine to those classes of milling in which it is permissible to feed the table in either direction. By having two fixtures on the table the operator may chuck a fresh piece in one fixture, while the machine is at work on the other, the table tripping and reversing as soon as a piece is finished without the loss of time due to removing and chucking pieces and running the table back by hand.

The feed-engaging levers act directly

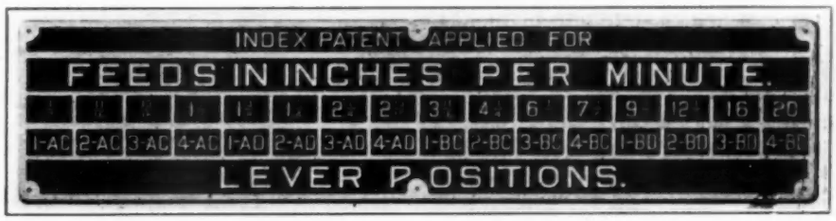

INDEX PATENT APPLIED FOR
FEEDS IN INCHES PER MINUTE.
1-AC 2-AC 3-AC 4-AC 1-AD 2-AD 3-AD 4-AD 1-BC 2-BC 3-BC 4-BC 1-BD 2-BD 3-BD 4-BD
LEVER POSITIONS.

FIG. 19. INCHES PER MINUTE FEED-INDEX PLATE

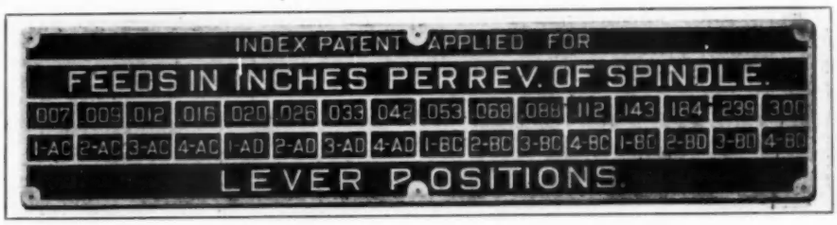

INDEX PATENT APPLIED FOR
FEEDS IN INCHES PER REV. OF SPINDLE.
.007 .009 .012 .016 .020 .026 .033 .042 .053 .068 .088 .112 .143 .184 .239 .300
1-AC 2-AC 3-AC 4-AC 1-AD 2-AD 3-AD 4-AD 1-BC 2-BC 3-BC 4-BC 1-BD 2-BD 3-BD 4-BD
LEVER POSITIONS.

FIG. 20. THOUSANDTHS PER REVOLUTION FEED-INDEX PLATE

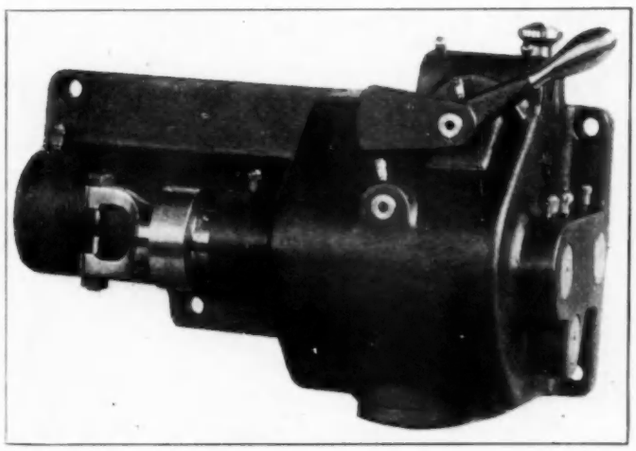


FIG. 21. OUTSIDE

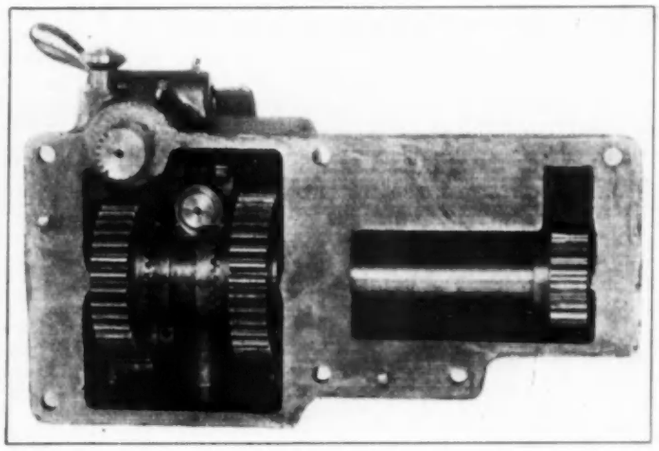


FIG. 22. INSIDE

FEED-TRIPPING AND REVERSING BOX

on the tripping plungers, lever *m* serving for the longitudinal, *n* for the crosswise, and *o* for the vertical feeds, and in each case the direction of movement of the lever is the same as that of the resulting feed. Thus to cause the table to feed to the right, lever *m* is moved to the right, and similarly to cause it to feed to the left, the lever is moved to the left. Again by lifting or depressing lever *o* the knee moves upward in the first case and downward in the second, and similarly for the cross-feed.

From the fact that one dog moves the tripping plunger *down* and the other moves it *up*, both moving it at all times toward its central or neutral position, it follows that the feed can always be thrown in for the reverse table movement immediately after it has been tripped without first running the dog off the plunger by hand, and since there is but one reversing clutch for all feeds, the relation of dogs and trip plungers can never be disturbed.

The Vertical-spindle Machine

The similarity of the vertical machine, Fig. 24, to the horizontal type has already been noted, the chief feature in addition to this which will impress the reader being the massive character of the head. It is the belief of the Cincinnati Milling Machine Company that there is a large amount of work done on other machines which is more suited to the vertical-spindle machine, provided it is fitted with all of the conveniences of the horizontal machine and has the same amount of stiffness and power. To this end the spindle has the same length as the one on a horizontal machine of equivalent size, and the bearings are duplicates of those used on the horizontal machine, both being permanently mounted in the headframe at the maximum distance apart, and the slide surfaces of the headframe are substantially as long as the spindle itself and of liberal width. The driving of the spindle is shown in Fig. 25, the spindle being splined in order to slide through the driving gear as the head is raised or lowered. Four stud bolts, clearly shown in Fig. 25, are provided, by which the head may be solidly bolted to the machine frame for heavy or repetition work. The gib platen, carrying the center gear on the spindle, and which also alines the vertical spindle head, is bolted to the machine in such a manner as to provide an adjustment which facilitates the proper realinement of the spindle at any time that this may be desirable. The head has a slow micrometer adjustment, obtained by a hand-wheel, and a quick adjustment of 6 inches per turn of the pilot wheel. A micrometer hand stop is also provided.

The table of the vertical being identical with that of the horizontal machine, it is possible to equip the former with a dividing head geared to the lead screw, and

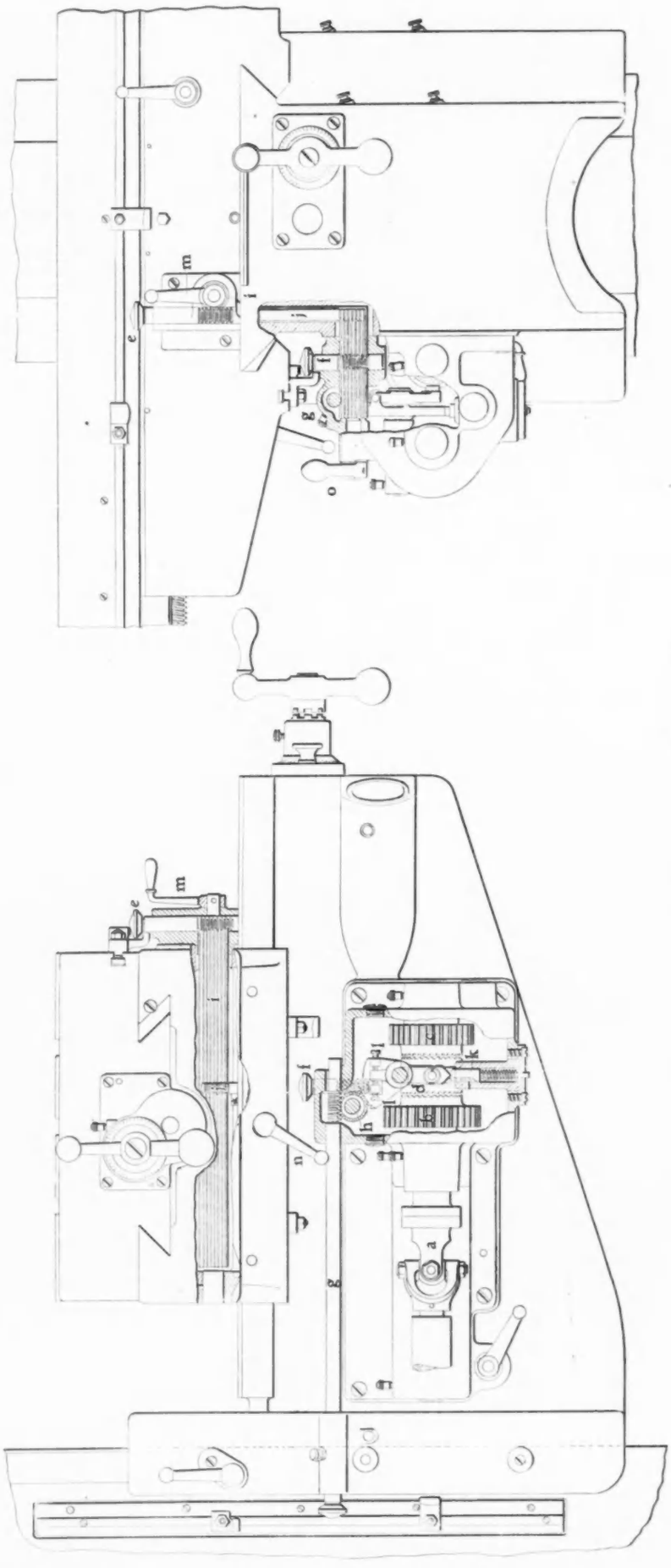


FIG. 23. FEED-TRIPPING MECHANISM

thus fit the machine for such spiral milling as can be done by means of an end mill held in the nose of the spindle.

The Circular Milling Attachment

A circular milling attachment proportioned for the same duty as the machines themselves is also provided, as shown in Fig. 24, and in detail in Fig. 26. It is driven from the feed box to the universal joint shaft independent of the regular feeding mechanism, so that both feeds may be used on the same place if desired. Thus, for example, by engaging the table feed a straight surface can be milled, and then by throwing this feed out and engaging the circular feed, an arc of a circle may be milled on the same piece. The attachment is provided with a reverse feed, similar to the one on the table feed, and it is also fitted with a hand feed and micrometer dial.

Referring to Fig. 26, *a* is the feed-operating and reversing lever, *b* is the hand-feed attachment, and *c* is a lever which disengages the power feed, for which purpose the driving worm is mounted in an eccentric sleeve controlled by this lever. The object of this arrangement is to permit quickly swinging the table into position for beginning the cut in those cases in which the milling comprises a portion of a circle only. The movement of the worm shaft for this disengagement is accomplished very neatly by the use of an Oldham coupling at *d*, which permits the worm shaft to be shifted parallel with itself without interfering with the driving connection with the short bevel-gear and clutch shaft *c*.

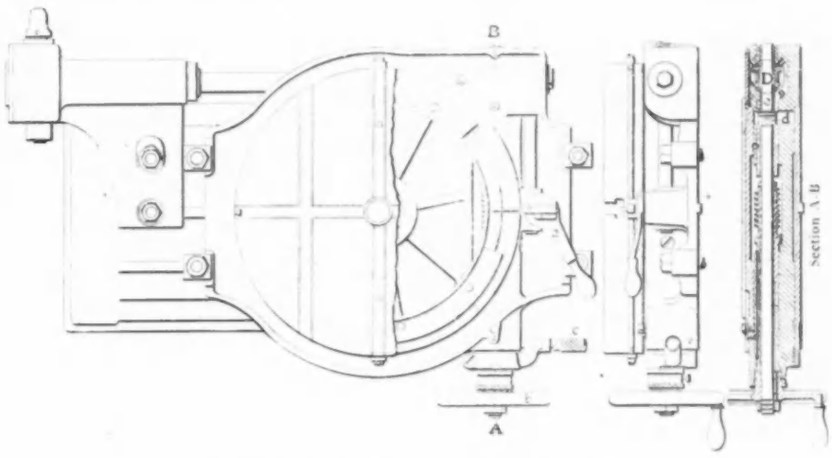


FIG. 26. CIRCULAR-MILLING ATTACHMENT

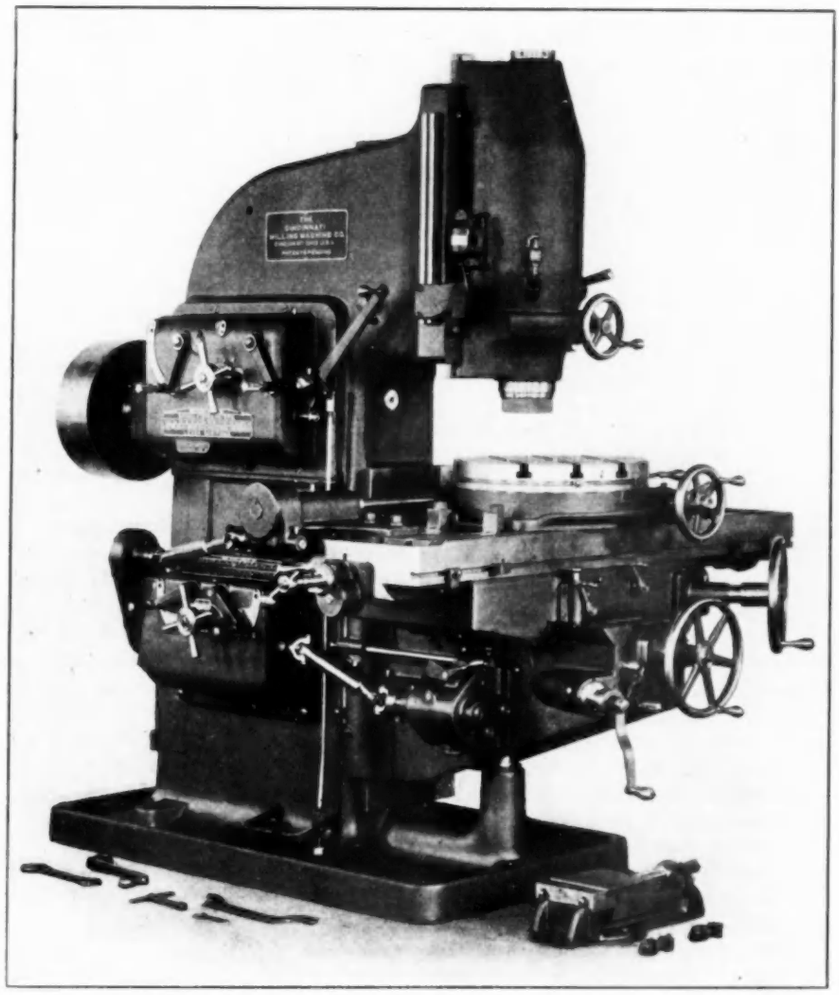


FIG. 24. VERTICAL-SPINDLE MACHINE WITH CONSTANT-SPEED DRIVE AND CIRCULAR-MILLING ATTACHMENT

High Efficiency Feed-screw

The readers of the American Machinist are well informed regarding the increased efficiency and reduced friction and wear of worms of increased pitch. The same principle obtains in the case of screws, albeit machine designers have been very slow to recognize the fact. The principle is applied in the present machines, however, all of the feed screws being made with double threads and of twice the usual pitch. A series of careful tests has proven the correctness of the theoretical considerations which led up to this design, the result being an increase in the efficiency and a reduction in the tendency to wear of about two to one. The end thrust of the table screw and of the elevating screw is moreover taken by ball-thrust bearings; the result of these two features being to so reduce the friction of the screw as to permit a quick return of 1 inch per turn of the hand-wheel.

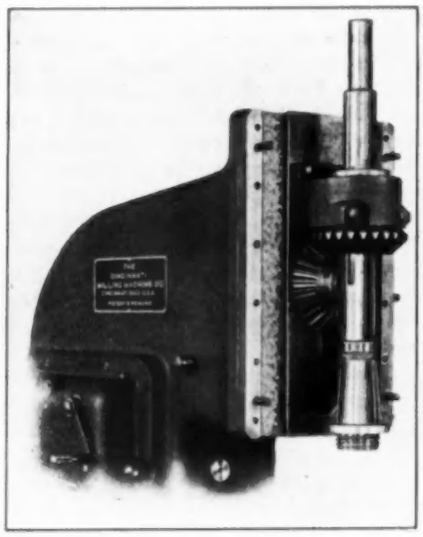


FIG. 25. SPINDLE DRIVE OF THE VERTICAL-SPINDLE MACHINE

Other Features

A feature of the feeding mechanism which deserves notice is that the only difference between machines having three power feeds and those having a single power feed is that in the latter case a portion of the feeding mechanism is omitted. This feature, which is another outgrowth of the unit system of construction, makes it feasible for a manufacturer to convert a single feed machine into a three-feed machine by merely supplying the missing parts.

Among other minor features is the forming of the base of the machine into an oil reservoir and settling chamber. Whether called for or not, the hub of the main driving pulley is fitted with a grooved pulley for driving an oil pump, and in case a machine was not initially fitted with such a pump it may be added at any time. Particular attention has been paid to lubrication, all main bearings having sight-feed lubricators, and all gears which run on studs or stationary shafts being oiled through a hole in the center of the shaft. In many cases, as, for example, the tumbler frames, several points are oiled from a single oil reservoir. In such cases the oil reservoirs are divided into as many compartments as there are pipes to be fed, a feature of the reservoirs being that the division walls between the compartments are low, the effect being to indicate at once any stoppage in a pipe, because of the fact that its reservoir does not drain.

The Outer-arbor Bearing Support

When a horizontal miller is working with cutters on an arbor, the outer arbor-bearing gets approximately as much of the pressure due to the cut as the main spindle bearing. It therefore is essential, on machines designed for heavy milling, that the outer arbor-bearing be supported as rigidly as practicable. On this line of machines this bearing is supported from the overhanging arm by a single-piece, truss-form brace, especially designed to resist side pressure, in the general direction in which the table moves. The proportions of this feature are made clear in the several illustrations of the complete machine.

F. A. H.

A good method of cleaning conveyer belts when the material handled is damp, according to the *Engineer and Iron Trades Advertiser*, is to provide some mechanism to clean the belt after it passes over the discharge pulley; otherwise a small quantity will be carried back by the return belt. For this purpose rotary brushes, made of various fibers, are used. These brushes revolve at a high speed, sweeping the material into the chutes. They are driven from the conveyer belts and are provided with means of adjustment for the wear of the fiber.

Trade Opportunities in Argentina, Bolivia, Paraguay and Uruguay

By M. de Moreira

All American manufacturers interested in South American export generally think that Argentina, Brazil and Chile are the only countries worth their interest. They are greatly mistaken. Opportunities, no doubt, are more frequent there, but they will find it worth their while to study smaller republics such as Bolivia, Paraguay and Uruguay. In these republics they will find possibilities overlooked by others on account of the smallness of the countries which, for that very reason, will give them nearly an exclusive territory.

Of all the presidents of the various South American republics none appreciate more the worth of the United States, as a manufacturing country, than the president-elect of Bolivia, who has passed many years in this country as minister from Bolivia to the United States.

A year ago the extent of the railway service there was only 418 miles, but since then the work of extending this means of communication has greatly increased.

Argentina

In accordance with treaties made with the Government, the Argentine republic has been authorized to build railway lines to Tupiza, a distance of 52 miles, and the natural railway center of southern Bolivia. Plans have already been made for the extension of that line which construction will not be long delayed.

Though the railway from the Atlantic to the southern part of Bolivia is not yet terminated, the Bolivian government has already taken steps for its prolongation northward by making an agreement with the Speyer-City Bank syndicate of the city of New York. The first part of the agreement is that the Government will set aside for that purpose $12,000,000, and the American syndicate $15,000,000. Bolivia having received from Brazil $10,000,000 indemnity for the limits settlement, can easily keep its promise.

The initial work of the syndicate is to fill the gaps in the Pan-American links, the first section of which is between Viacha, on the railway line between Lake Titicaca and La Paz, and the city of Oruro, a distance of 128 miles. This line should be completed by now. Arriving at Oruro the line will make junction with the Antofagasta and Bolivia railway. The tracks will be used by both companies between Oruro and Uyuni.

As the distance from Oruro to Uyuni is 195 miles, in a very short time 323 miles of the main trunk of the Pan-American line will be in operation in Bolivia. Surely with a home syndicate, American manufacturers will find all facilities to have their machinery used in the building of this road as well as their machine tools employed in their different shops.

The government has also under consideration the construction of a line from La Paz to the navigable waters of the river Beni with connections by steamers to the Amazon by the Mamore and Madeira rivers. The total sum to be expended for these undertakings will be $150,000,000, the greater part of which has already been raised.

Bolivia

There are rich mines in Bolivia, as nearly all minerals known in the world are found there. The tin mines are, of course, the richest, but those of gold, silver, bismuth and copper are very productive. Modern mining machinery would find a good field there, and would save manual labor, which is very scarce. The Government, wishing to develop this industry, has granted free duty to all mining machinery coming from the United States.

One word of advice is needed here regarding the shipment of any kind of machinery to Bolivia. On account of the difficulty of inland transportation, the manufacturer must see that the instructions of the buyers are followed very closely, as shipping clerks have very fancy notions of transportation means in other countries, and are very often of the "know it all" kind, with the results that many times the manufacturer blames the buyer for refusing to accept the goods shipped, whereas he should discharge his shipping clerk for having shipped the goods otherwise than per instructions, as it is impossible for the purchaser to have them transported inland except by repacking at a great expense.

While at some seasons the central Bolivian plateau has water in abundance, artificial means of irrigation are necessary. The Government has tried American well-drilling machines with good results. The manufacturers, however, have not pushed their sale as they should, and according to reliable information, more are needed. American manufacturers who send agents to Argentina have all facilities to test the possibilities of creating a market in southern Bolivia, and should not let the opportunities of all these planned works escape them.

Paraguay

Paraguay is, on account of its isolated geographical position, somewhat behind in progress. The only railroad of the republic covers a distance of but 225 miles. They are working on an extension of the present line which, when terminated, will connect the Central Railway of Paraguay with the Argentina Northeastern, and thus bring the capital, Asuncion, within 50 hours of Buenos Ayres by an all-rail route.

Another road is planned called the Asuncion-Santos road. That road will go

through very valuable timber land and pass by the Guayra, whose falls have a greater volume than Niagara. The opportunities are not large, still the continuation of the railways, as well as the erection of a packing establishment should permit manufacturers to supply some needed machinery.

URUGUAY

Uruguay is by many manufacturers considered as a part of Argentina, and by others as consisting of only one city, Montevideo. Both ideas are erroneous. Uruguay is a very progressive little republic. Its financial situation clearly indicates its welfare, prosperity and progress. Its last financial year showed a treasury surplus of over $2,000,000.

There, like in the other South American republics, the United States is behind in its exports. Out of $34,425,205 exported to Uruguay last year, the United States only furnished $3,971,001, or 11.5 per cent.

Uruguay is essentially an agricultural country, but in spite of that there are a few opportunities for American manufacturers of machinery and machine tools. The French mining company of Cunapiru and the mines of San Gregorio and Ernestinita are very progressive and anxious to possess uptodate implements. The maritime transportation offers still greater inducements. Native companies of steamers and steam launches which carry passengers and merchandise between Montevideo and Buenos Ayres, one night's journey, are building their own steamers and launches.

Their building and repair shops are very well equipped and offer our manufacturers great opportunities and an easy delivery.

Jig for Reaming Worn Chain Links

By C. K. Witmer

In the operation of chain coal-mining machines one of the expenses entailed is the maintenance of the chain. Fig. 1 shows this type of chain. When the holes in the blocks, which hold the picks and through which the lugs of side straps and rivets pass, become elongated from wear, the chains climb the driving sprocket as the pitch of chain is too great by the amount of elongation of these holes. It has been the practice to throw these pick blocks in the scrap when the holes became badly worn. This entailed an expense of $1.05 for every pick block purchased for renewal. The jig, shown in Fig 2, was made for the purpose of reaming these worn holes.

By looking at the chain in Fig. 1, it will be observed that the pick-block links face in various directions to stagger the picks. It was, therefore, necessary in making a jig to hold all of these links that the link should be held true with the machined part.

By placing the link in the jig while the top is off and drawing up on the two nuts behind, which draw taper bolt heads up against the round portion of the link above the point where there is excessive wear from the sprocket teeth, the back of the link is drawn up solid against the back of the jig, which properly locates the holes with relation to the steel bushings. When the top of the jig is replaced and firmly tightened with the two hinge bolts, the faces of the bushings firmly clamp the sides of the pick block on the faces which are protected by the side straps from excessive wear and abrasion in passing through the guides and coal. The link or pick block is thus held firmly and in the proper position to be reamed without any measuring or adjusting. The holes are reamed with a three-grooved high-speed reamer. The bushings for the blocks are made from seamless tubing, and in order to make them tight we drive a hardened-steel drift, like Fig. 3, through the bush after placing it in the block. This expands the bushings, making them tight in the block and leaves the holes smooth and of a uniform size if the drift is lubricated with soap water or drilling compound.

We tried case-hardening these bushings, but did not find it a success as they would crack and break in service owing to the severe strain and shocks; and it was also hard to fit the pick blocks properly.

After a set of bushings become worn too badly in the chain they can be renewed by placing the link on a suitable block and driving out with a drift similar to Fig. 4, when the new bushings can be put in as before.

It costs to bore these links and bush them about 10 cents a link, and to rebush them about 4 cents. A link that has been bushed gives about the same service as a new link does, which costs $1.05.

In service we find a link or pick block will stand boring out and bushing and from one to two rebushings before the other part of the block is so badly worn that it has to be thrown away.

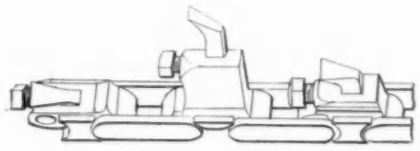


FIG. 1. SECTION OF CHAIN

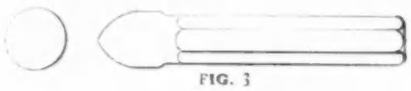


FIG. 3

FIG. 4

DRIFTS FOR CHAIN BUSHINGS

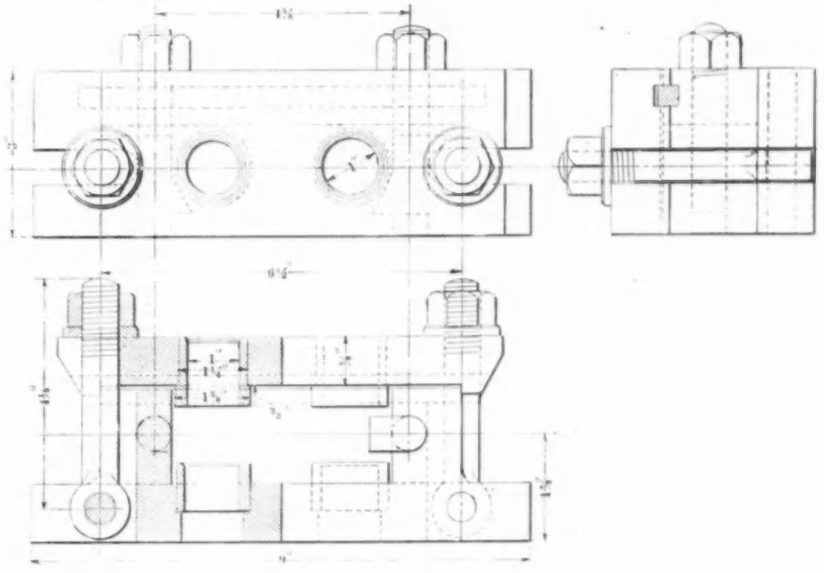


FIG. 2. THE JIG

The introduction of safety razors in Scotland was slow, but now they are quite popular. The American article leads, as it is recognized that manufacturers of the United States are in the lead in the art of tempering thin-blade steel.

Points of Interest in a Railroad Shop

Some of the Special Tools and Methods in Use in the Various Departments of the Chicago and Alton Shops at Bloomington, Illinois

BY ETHAN VIALL

The railroad shops of the Alton system are at Bloomington, Ill., and a few weeks ago, through their mechanical engineer, J. H. Leyonmarck, I obtained permission to go through the various departments and photograph and describe anything I saw fit. The number of departments and the variety of work done would furnish many days of profitable employment to any observing mechanic fortunate enough to have the chance of seeing them. The machine shop is in charge of William Hall, who is assisted by J. C. Murray, route foreman. These two men are responsible for many of the "kinks," not only in the machine shop, but in the other departments as well.

Main-rod Brasses

Fig. 1 shows the fixture used on the shaper for machining the outside of brass boxes. The two halves are placed together and clamped, as shown; one side is then planed off, the box indexed a quarter of a turn by means of the pin shown at the left end of fixture. This side is then machined and the operation repeated until finished.

In one corner of the shop stands the four-spindle drill press, shown in Fig. 2, which is used for drilling the tell-tale holes in the ends of stay bolts, all of approximately the same diameter, and so the eccentric clamps make an effective way of holding them. The work is so nearly the same size that no means of adjustment, other than shown, is needed.

Holding Half-round Brasses

Fig. 3 is a mandrel used for holding half-round box brasses. The pointed screws are used to center the piece, while the clamp hooks catch the small lugs cast on the inside of the brass and hold it firmly when the nuts on top of the cross-piece are tightened. This mandrel enables a man to turn the outside and both ends of the brasses at one setting.

On the boring mill, where many of the big locomotive-piston rings are turned, some means had to be provided to keep

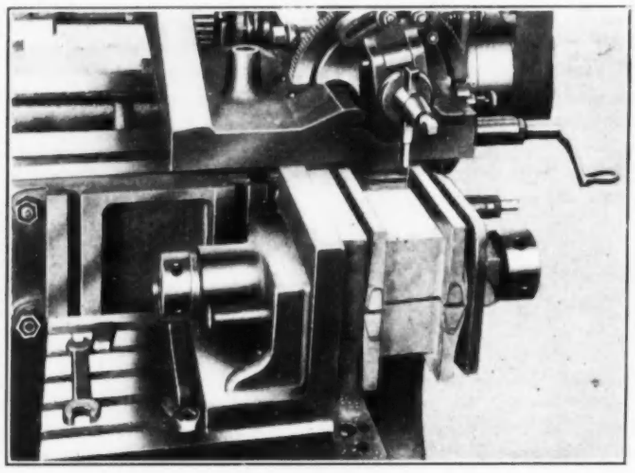


FIG. 1. SHAPER FIXTURE FOR BOXES

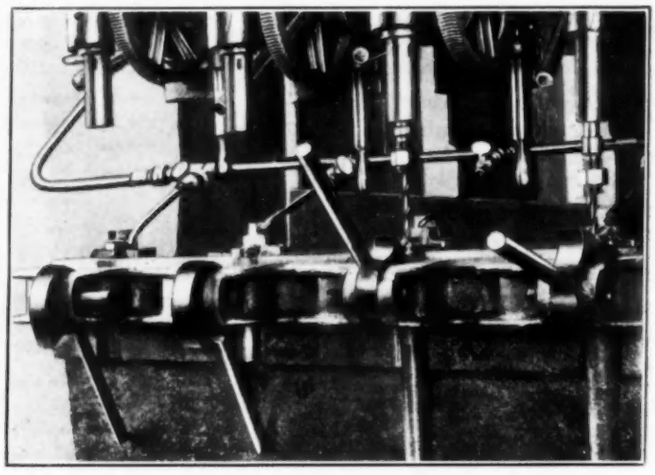


FIG. 2. DRILLING SLAGBOLTS

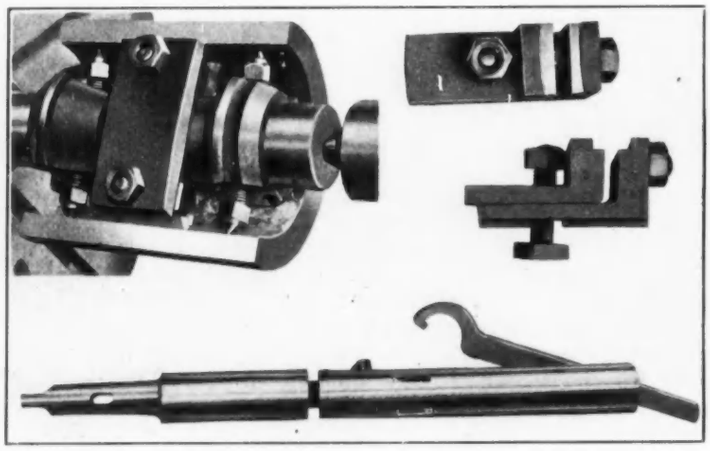


FIG. 3. MANDREL FOR TURNING HALF BOXES FIG. 4. CYLINDER CHUCK JAWS
FIG. 6. BORING BAR

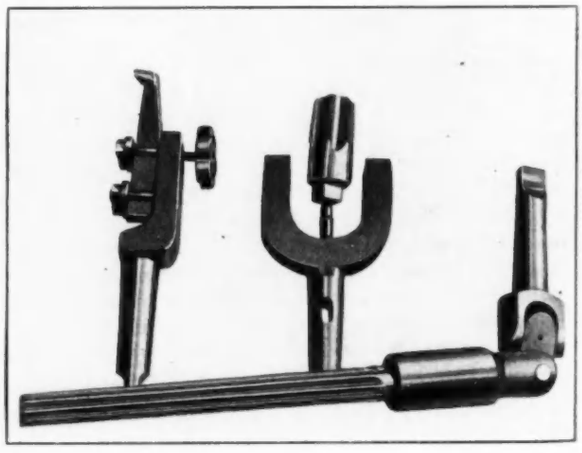


FIG. 5. THREE DRILL-PRESS TOOLS

the chuck jaws from springing the cast cylinders out of shape, so the operator, Ford, had the jaws, shown in Fig. 4, made. The use of these is so obvious that no explanation is needed.

Three Drill-press Tools

In Fig. 5 three drill-press tools are shown. The one on the right is a floating

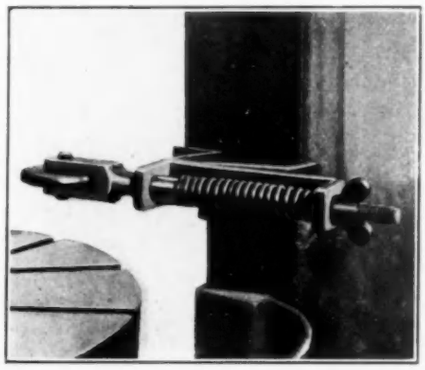


FIG. 7. TRUING DEVICE FOR MILL

reamer holder of a rather common type. In the middle is a fork for turning a tap wrench, while the one on the left is for boring out or chambering a hole.

When a hole is to be chambered out, the tool is lowered the proper distance into the hole, the nuts opposite the hand-wheel loosened and the tool set out by screwing in the hand-wheel.

A Boring Bar that Holds the Tool Fast

A piece of steel is set under the stationary clamp for the tool to rock on as it the tool, to prevent wear or spreading. A spanner wrench is used to tighten or loosen the tool. While this bar has some obvious faults, extreme accuracy is not called for on the work it does.

Fig. 7 is a gage clamped to the side of a boring mill for quickly centering certain round castings. The spring allows for any small lumps and also allows a limited adjustment.

To save filing the scores of beading tools used in the boiler shop, they are milled in the tool room, as shown in Fig. 8.

Handling Wheels on the Floor and in the Lathe

In the wheel and axle shop the first thing that the foreman, T. H. Hobbs, showed me was the "turntable," shown in Fig. 9. This is simply a big air cylinder set into the ground, with a Y-shaped piston-rod. A pair of wheels is rolled up until the axle is over the Y, the air is turned on and the wheels are lifted clear of the rails and may be easily swung in any direction. A pressure of the foot on the air-valve lever sets the wheels down lightly and quickly. Next was the big Pond wheel lathe. This is one of the kind that drives from the middle of the axle, a section of the driving gear of the lathe being removable for the purpose of admitting the axle.

Originally the wheels had to be run in by using crowbars and strong language, but now the device, shown in Figs. 11 and 12, does the work without any trouble.

The device consists simply of two levers hinged onto the lathe, and securely fast-

The Blacksmith Shop

Next came the blacksmith shop in charge of Samuel Morgan.

Nearly all of the lighter bending in this department is done on pneumatic bulldozers. These bulldozers, like many of the devices in this and other railroad shops, have been made "at home," and the power is supplied by either new or second-

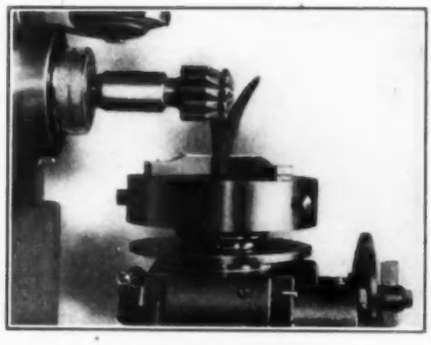


FIG. 8. MILLING THE BEADERS

hand air brake or air pump cylinders. One of these bulldozers was making loop, or "stirrup," handles, such as are used on pokers, clinker irons and the like.

Bending Dies at Work

Fig. 13 shows the bending fixture and the first operation finished, with the machine ready to start the second bend. In making the first bend the arm *A* is swung to one side and the plunger acts directly on arm *B*. After completing the first bend the plunger is drawn back and the arm set, as shown; the air is again turned on and the bend finished, as shown in Fig. 14.

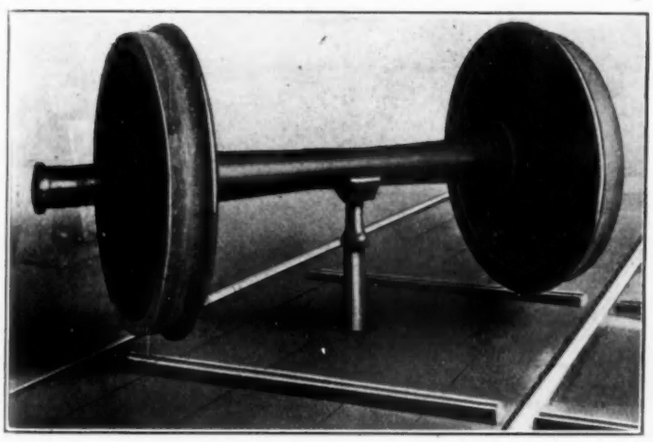


FIG. 9. AIR TURNTABLE FOR WHEELS

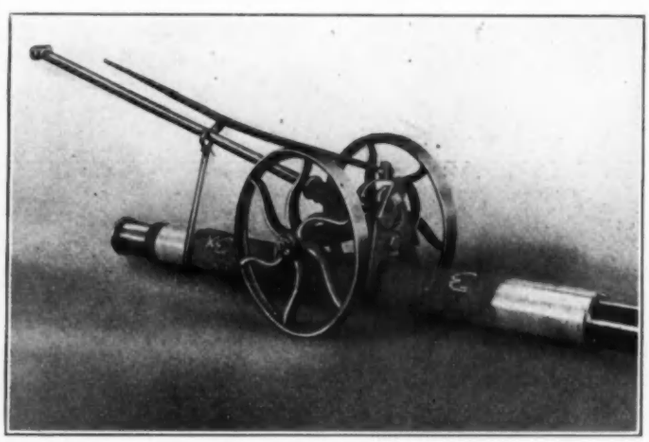


FIG. 10. TRUCK FOR CARRYING AXLES

is adjusted. The great advantage of this device is that any lathe-boring tool of the right size may be used.

A boring bar used for many jobs and which has the merit of holding the tool tighter the harder the cut, is shown in Fig. 6. As will be readily seen, the shank part screws into the other. There is a piece of hardened-tool steel set in the end of the screw plug, where it butts against

ened together. The operating power is supplied by an air cylinder set partly in the foundation, as shown.

With this arrangement one man can easily put in a pair of wheels, the most time being taken up in removing and replacing the section of the driving gear.

Fig. 10 is a small hand truck for handling axles, where it isn't desirable to use the pneumatic hoist.

Unsatisfactory attempts have been made to make this loop at one stroke, but the failures have been principally due to the shortness of the stroke of the air machines.

Two More Bending Jobs

Fig. 15 shows the manner of bending another shape of loop. This is also done in an air machine. These cuts were all

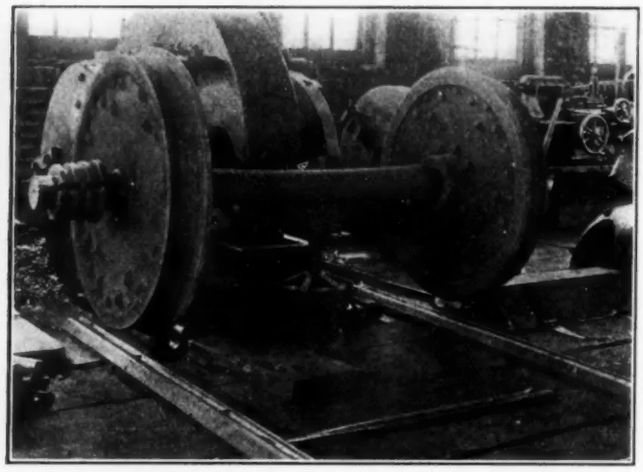
taken with the camera on top of the machine and pointing down. The machine itself is little more than an air cylinder mounted on an iron bed so no attempt was made to photograph it.

The rig for bending eye bolts is shown in Fig. 16. In this, the circular piece *A* has a pinion on the under side which is operated by the rack *B*, which is bolted to the plunger of the air cylinder. As the machine makes the stroke *A* part revolves, and the block *C* pushes the end of the bolt around the pin, forming the eye. The cut shows the jig at about half stroke, in which position the bend would be about half completed.

Making Grease Into Cakes

In looking through the oil storage building I ran across a press used to form the big cakes of grease used on the engines. This grease is almost as stiff as common soap, and is pressed into cakes about four inches thick, eight inches wide and ten inches long, with a half-round hollow in one side running lengthwise. In this press were the ever-present air cylinder as shown in Fig. 18.

The upper cylinder is used to compress the grease into the forming mold and the



FIGS. 11 AND 12. DEVICE FOR HANDLING CAR WHEELS IN THE LATHE

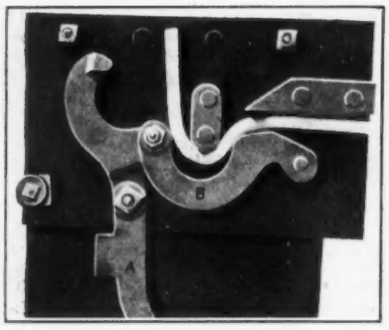


FIG. 13. FIRST OPERATION

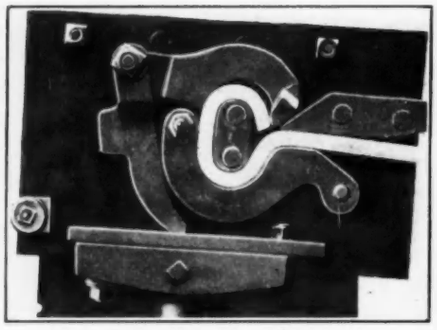


FIG. 14. FINISHING THE BEND

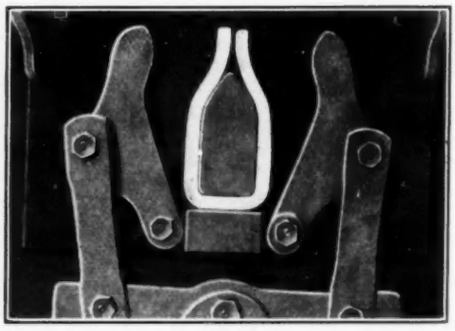


FIG. 15. ANOTHER STYLE BEND

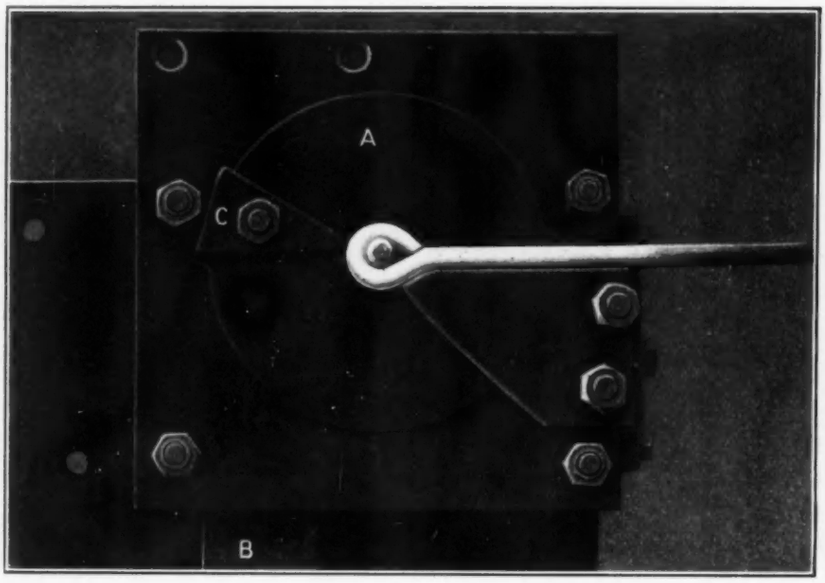


FIG. 16. FIXTURE FOR BENDING EYE BOLTS

FIG. 17. PORTABLE FORGE

lower cylinder forces the cake out. A cake of grease is shown at the left of the mold.

In the boiler shop a little rivet heater on wheels, Fig. 17, attracted my attention. It is very handy as it can be moved wherever wanted, a hose connected to the compressed air supply furnishes the blast, coke being used as fuel.

Knocking off Rivet Heads

The way rivet and stay bolt heads are knocked off is used in a number of other boiler shops, but it may be new to some of the readers. The machine used is a special form of pneumatic hammer shown in Fig. 19. The body of the machine is a cylinder inside of which slides a 46-pound hammer made of a piece of round-bar steel. A small pipe, shown in cut, lets air in at either end of cylinder, according to the way the valve is shown. The hammer has a stroke of about five feet and strikes a powerful blow. The cutting chisel, which is about the size of a big crowbar, is inserted in the business end of the cylinder, a rubber ball is placed in the other end to break the shock of the returning hammer, though it returns slowly, of course.

The whole outfit is running from a traveling framework or crane. A hook, with rope and pulleys, fastened to the boiler on which work is being done, keeps the crane from being driven back by the blows. Three men are required to work this hammer, one guiding the chisel, one working the position of the machine, and the other operating the air valves. When properly placed, one blow of this hammer will take the head off of the largest rivet. After cutting off the heads the same machine is used to punch out the rivets.

Swaging and Welding Flues

Fig. 20 is a pneumatic flue-swaging machine and is an especial pet of Frank Gray, foreman of the boilermakers. From left to right the swaging dies get smaller. The short pieces of flues are heated and quickly swaged down by passing from one hole to another.

When welding these short pieces onto a flue, one is taken and slipped onto the pin shown projecting at the bottom of machine, the end of the flue is heated and rammed on over the end of the short piece. This lap is then heated and welded. An oil furnace is used for this and it throws the heat exactly where it is wanted. A pile of newly welded flues is shown in Fig. 21.

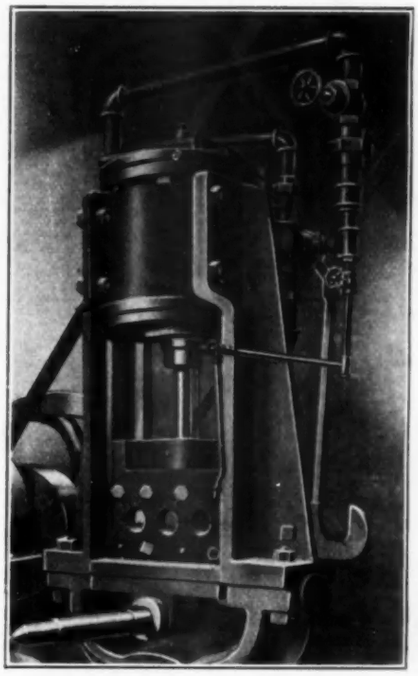
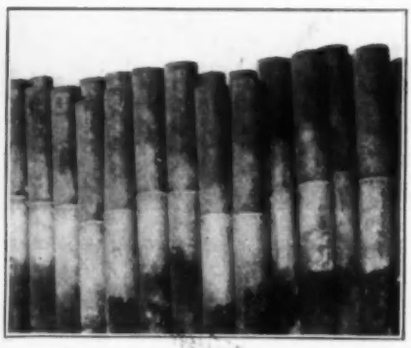


FIG. 20. MACHINE FOR SWAGING FLUES, OPERATED BY AIR



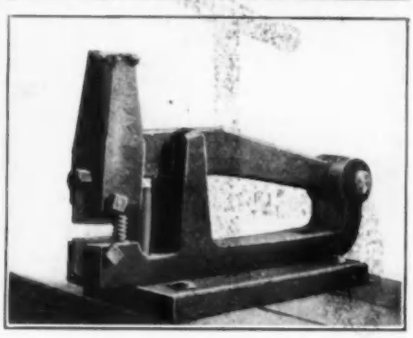


FIG. 21. SAFE ENDS OF FLUES

FIG. 22. BRAKE HOSE BOLT CLIPPER

Air Brake Repairs

The air-brake department has the usual testing devices, but some of the machines used for replacing worn air-brake coupling hose are different from others that I have seen and are mostly the design of John Lansburg, who is the air-brake expert for both the Alton and the Clover Leaf railroads.

The bolt clipper used to cut the clamp bolts is shown in Fig. 22, a heavy hammer and a good right arm being the means of operating it. After the bolt is cut the connection is pulled out in the machine, shown in Fig. 23, which needs no ex-

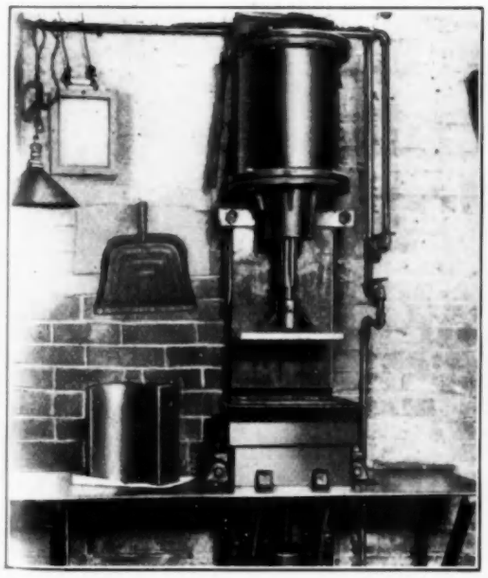


FIG. 18. PRESSING CAKES OF GREASE

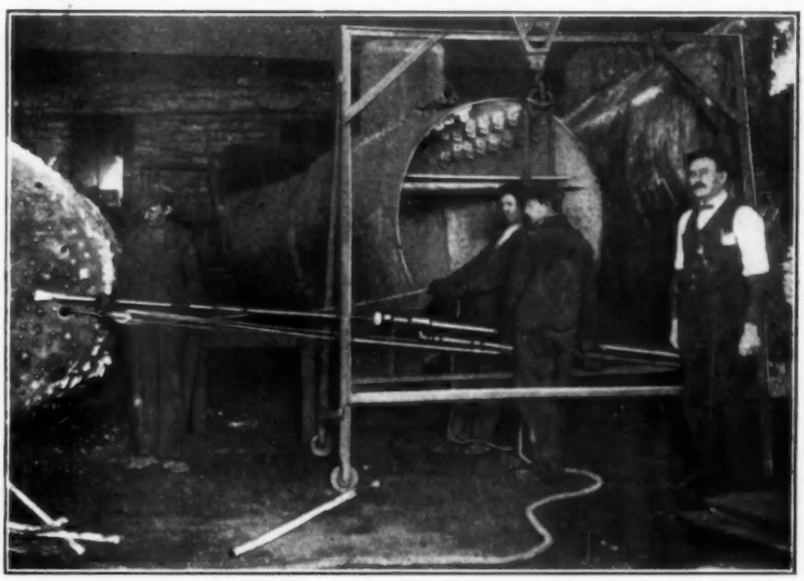


FIG. 19. KNOCKING OFF RIVET HEADS

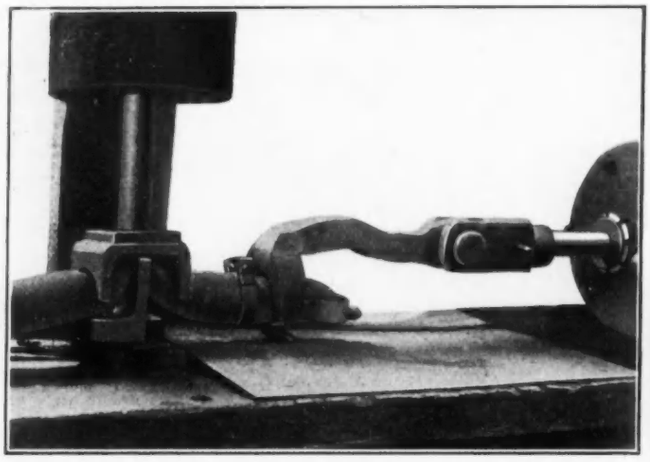


FIG. 23. PULLING OUT OLD HOSE COUPLINGS

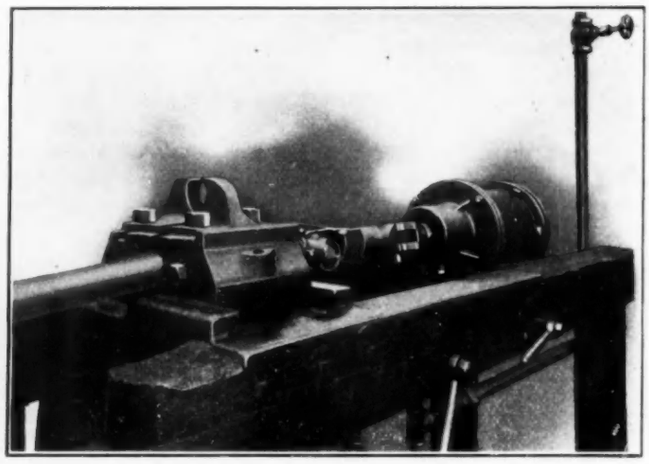


FIG. 24. PUTTING ON NEW ONES

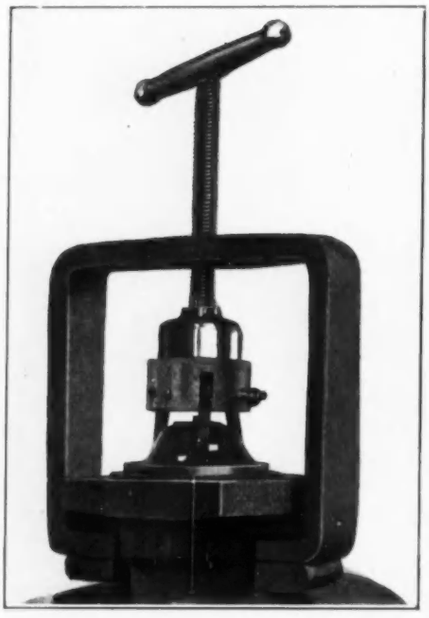


FIG. 25. AIR-PUMP VALVE PULLER

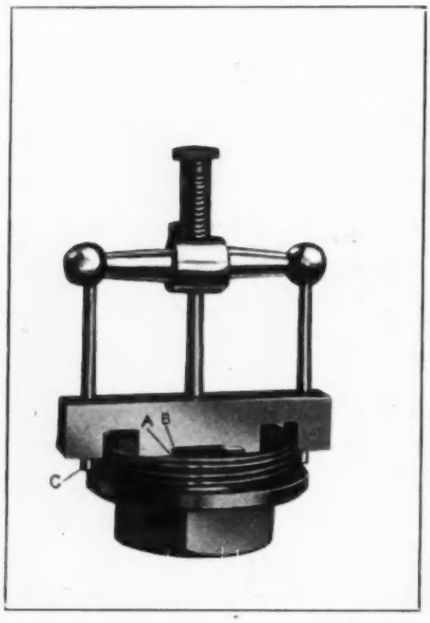


FIG. 26. GAGE FOR LIFT OF AIR VALVE

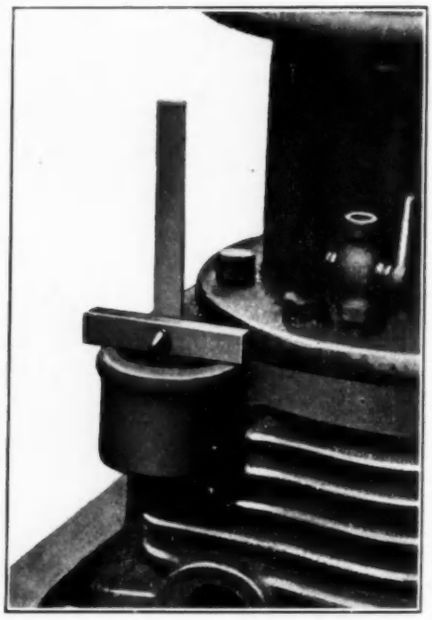


FIG. 27. MEASURING VALVE CHAMBER

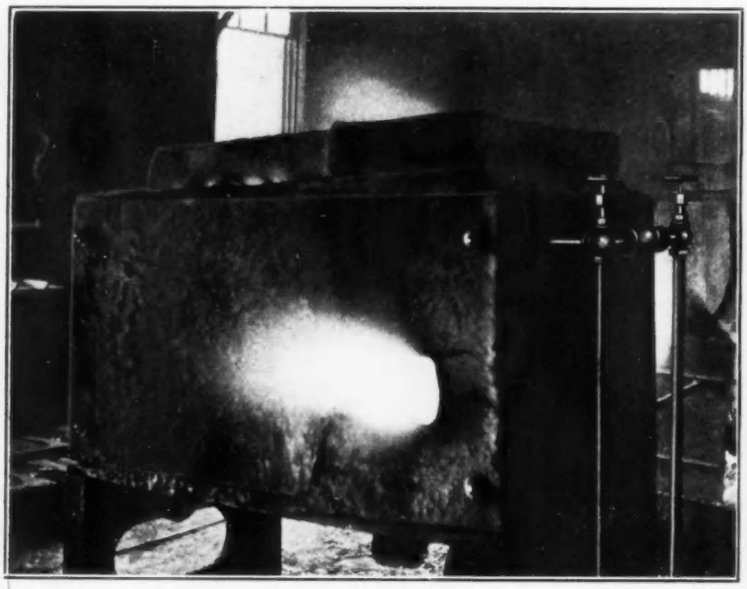


FIG. 28. MELTING BRASS WITHOUT A CRUCIBLE

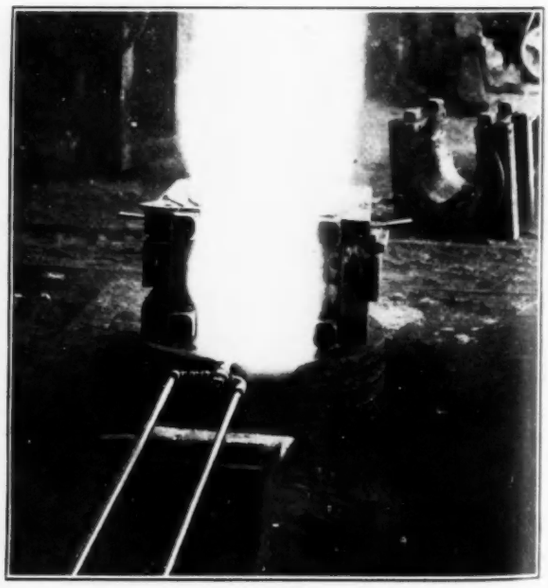


FIG. 29. CASTING BRONZE BEARINGS IN AN IRON BOX

planation. The machine for holding the new hose and pushing in the coupling is shown in Fig. 24. This machine is also intended to close the clamp while the bolt is tightened, the jaws on top of the machine being used for this.

Fig. 25 shows a device used for pulling out parts of old valves that usually stick and which have little that can be gotten hold of to loosen and pull them out. Air valves must be set so that the lift is correct and as the depth of the inside of the caps varies, the gage, shown in Fig. 26, was made. The part of the gage at *A* rests on the bottom of the hollow inside the cap, the rods at *C* rest on the cap shoulder, and the distance from *A* to *B* is the amount allowed for the lift of the valve.

After this gage is set, a depth gage is laid across the ends of the gage at *C* and the depth to the bottom of *B* is taken. The depth gage is now used as Fig. 27 shows, the top of the valve being filed off to suit.

The Brass Foundry

In the foundry I discovered little out of the usual run except that all their brass is melted without using crucibles and while this is not new there are not many that melt their brass that way. The style of furnace used is of the box type with drop bottom as shown in Fig. 28.

Oil and compressed air are used for fuel, the blast being blown into the furnace through a small hole opposite where the valves are shown in cut. The hole in the side from which the flame is seen to be issuing is used to skim off the slag or add more material. The metal is tapped from the front in the usual way.

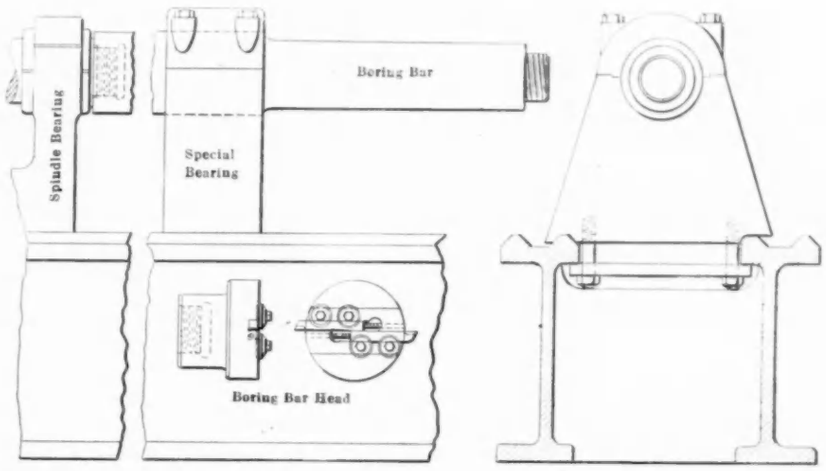
In melting brass in this way with crude oil, an exceedingly refractory carbon compound is formed, which will not melt and must be skimmed off. If it becomes mixed with the melted brass, flaws will develop in the castings. There is also considerable waste otherwise, but it is considered that cost of crucibles by the other method more than offsets this loss.

In the driving-wheel boxes the brasses are cast directly into the iron box. These boxes are first heated and expanded so that they measure ⅜ of an inch more across the ends. This expanding is done by using an oil blow pipe as shown in Fig. 29. After they are heated and expanded the right amount, a special mandrel arrangement is inserted and the brass poured. A finished box is shown at the right and to the rear of cut. This way of casting in the brass saves machining the outside and fitting it in and as the iron box shrinks back into shape the brass is held tightly and securely in place. The brasses are next bored out and fitted.

Boring Small Cylinders on a Lathe

By W. P. Hunt

Some time ago the Moline Tool Company had a contract to bore a lot of gasolene-engine cylinders and rigged up one of the lathes for a boring machine in a way, that, while it is not new, we believe if its merits were better understood, it would be more generally used.



RIG FOR BORING SMALL CYLINDERS ON THE LATHE

It proved itself so efficient, that two local concerns building gasolene engines have fitted up lathes in the same way and are getting very good results from them.

The lathe we used had rather a long bed, so we used a bar about 5 feet long and 5 inches in diameter for a boring bar. The outer end we threaded to fit the boring heads, which will be described later. The rear end we fitted into the bore of a 3-jaw chuck, although in our sketch we show it threaded to fit the nose of the spindle, which we think is probably the better plan.

We have a heavy bearing for the bar, which we fitted to one V of the lathe bed and allowed the bar to project far enough beyond it for boring the job we had in hand. This bearing we made very heavy, bolted it securely to the lathe bed and babbitted it in place.

We made a suitable jig for holding the cylinders on the lathe carriage, but as it is of very ordinary construction and each style cylinder might possibly require variation in the style of the jig, I will not describe it. The boring heads were threaded to fit the nose of the boring bar and flatted to allow a wrench to be used for readily removing them. Each head had two cutters, which were set in slots so that the cutting edges were radial. Each cutter was held by two cap screws having case-hardened clamping washers, which bore on top of the cutter and on the face of the cutter head, as shown in the sketch. The surface of the cutter head was relieved so that these clamping washers would only bear on the back edge. Each cutter was set out to position by a headless set-screw directly back of it.

We made a roughing and a finishing cutter head so as to avoid changing tools. We also drilled a hole in the side of the finishing cutter head into which we slipped a small cutter for beveling the end of the cylinder to allow the piston rings to be entered readily.

After running the second cutter head through, we had a reamer to screw on to the end of the bar. Instead of pushing this through, we reversed the feed of the carriage and pulled it through. This seemed to give better results than the customary way, although, of course, it cannot be used in a cylinder having a closed end.

For facing the ends of the cylinders, we first used a sweep tool, which gave fair results, when we used a notched tool to remove the scale.

We then made a facing arm with a traveling head, on which the tool was fed out by a star wheel on the outer end of the feed screw. For all-around work, we think this is the better plan.

By using a comparatively long bar, not only is the rig made very stiff, but the carriage is brought on to a part of the lathe bed which in ordinary lathes is practically not worn at all, so it is an easy matter to keep it gibbed to the bed uniformly.

We discovered one thing while boring the cylinders with this rig, which rather surprised us. After our cylinders got cold, we found one of them was not exactly round, and finally we discovered that the trouble was due to the fact that the removing of the roughing cut released strains in the castings and allowed them to change their shape. We overcame this by removing the cylinders and allowing them to cool or season after taking the roughing cut.

Chain Drive for Automatic Forming Machines

The Advantages of This Smooth and Positive Spindle Drive Are Indicated by the Quality and Quantity of Work Produced

SPECIAL CORRESPONDENCE

In the automatic-turning department of the works of Hans Renold, Limited, Manchester, England, the line shafts and countershafts are driven by Renold silent chains from a series of motors, as illustrated in these columns at page 416, Part 1. For some years this chain drive has been applied to the spindles of a number of Brown & Sharpe automatic-forming machines, of which there are over 160 in the department referred to and the results obtained with this form of drive have been so satisfactory that it is now employed on 12 of the large size of automatics and is shortly to be applied to 12 more machines.

Two Methods of Driving Spindles

In order to compare the two methods of driving the spindles, two similar machines, one with chain drive, Fig. 1, and the other driven by belt were set up for the same size of work, which consisted of drilling, reaming and cutting off from the bar, steel rollers 1 inch diameter and 1 inch long, the hole in the rolls having a diameter of ¾ inch. These machines were Brown & Sharpe No. 2 automatic-forming machines, and it should be stated here that their maximum capacity as given by the builders is ⅞ inch diameter for steel work, the extra capacity of 1 inch being recommended only for brass or other light work. Thus the machines operated during the tests were run on somewhat larger and heavier work than they were actually designed to handle. The results are sufficiently striking to be of considerable importance to users of automatic turret and similar machines.

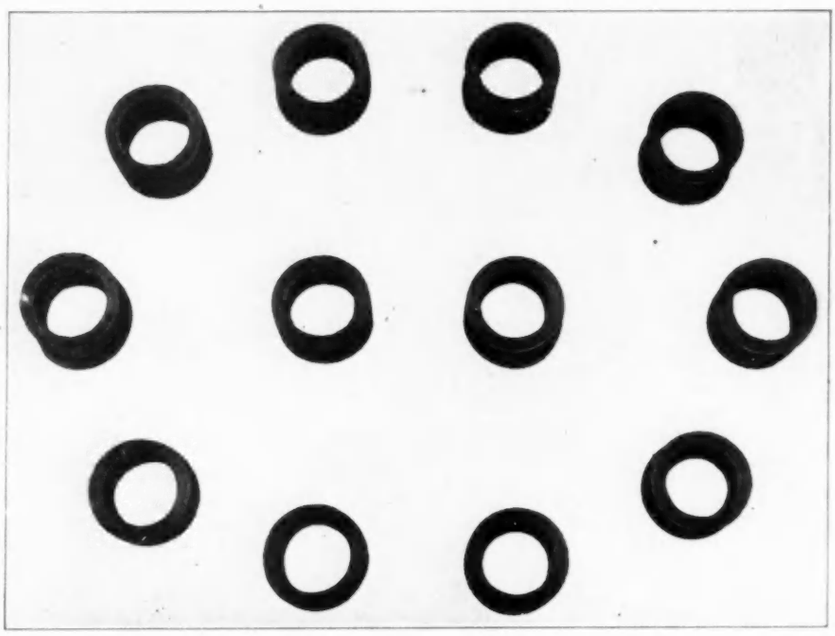


FIG. 2. ROLLERS MADE ON THE BELT-DRIVEN MACHINE

FIG. 3. ROLLERS MADE ON THE CHAIN-DRIVEN MACHINE

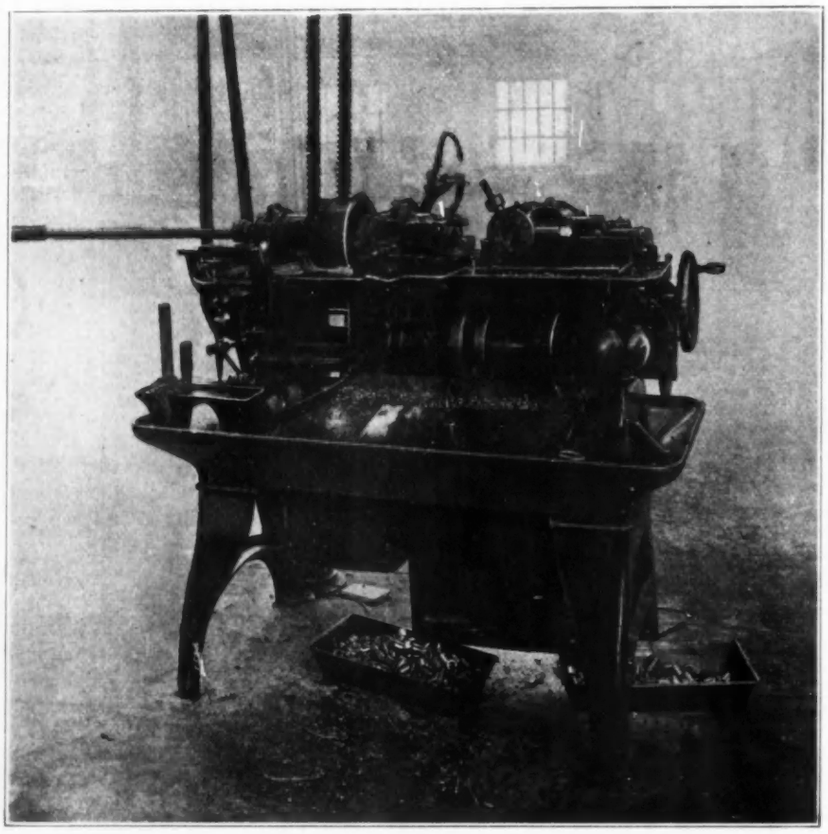


FIG. 1. BROWNE & SHARPE AUTOMATIC FORMING MACHINE WITH SPINDLE DRIVEN BY RENOLD SILENT CHAIN

Results of the Trial

During a trial of 138 hours, the chain-driven machine produced 3074 rollers and the belt-driven machine 2485, a difference of 589 or 23½ per cent. in favor of the machine with chain drive. It is stated by the company that during the past two years the production record has regularly shown 20 per cent. in favor of the chain-driven machines; this increase not being from the largest size of work alone, although for some time the larger work has been done on the chain machines.

From the rollers made during the trial, six of average quality were taken from each machine. Those produced on the belt machine are shown in Fig. 2, while the product of the chain machine is shown in Fig. 3. The results due to the smooth, steady drive of the chain during the cutting-off operation are clearly rep-

resented. The action of the drill in the two groups of rollers is not illustrated, as the reamer in taking a light cut through the holes produced smooth surfaces in the case of each machine.

Effect on Tools

Still more striking, perhaps, than the difference in the character of the surfaces produced by the cutting-off tools of the two machines, are the relative effects on the tools themselves and on the drills. Considering for the moment the action upon the drills, Fig. 4 may be referred to as an illustration of considerable interest. At *A* in this engraving, is shown a new drill 9¾ inches long. *B* shows the drill worn or ground away 1⅜ inches during 138 hours operation in the chain-driven automatic, during which time it drilled 3074 rollers and was sharpened twice. *C* and *D* are two drills, one worn or ground back 4¼ inches and the other 1¾ inches. These were used in the belt-driven machine during the 138 hours and drilled 2485 rollers. The two drills were ground ten times in this period. It will be noticed that drill *C* is reduced to the shortest length usable.

The drilling was done in the belt-driven machine with a speed at the circumference of the ¾-inch drill of 93.75 feet per minute; the feed per revolution was 0.0028 inch. The drilling speed on the chain-driven machine was 56.25 feet per minute; the feed per revolution 0.0046 inch. An attempt was made to drill at the lower speed given on the belt-driven machine, but the results were so unsatisfactory that the belt was changed to the next step on the cone, which gave a speed of 93.75 feet as noted above. For lubricant a good supply of lard oil under fair pressure was used.

Cutting-off Tools

The illustrations of the cutting-off tools actually used on the two machines are quite as interesting as those showing the drills. Fig. 5 represents the type of tool used, the diameter being 3 inches, the thickness ⅜ inch, the thickness of cutting edge 3/32 inch, the depth of cut made in the parting operation ⅛ inch. The tool to the left in Fig. 5 is shown in just the condition in which it was started at work in the chain-driven machine. The view to the right indicates the slight amount

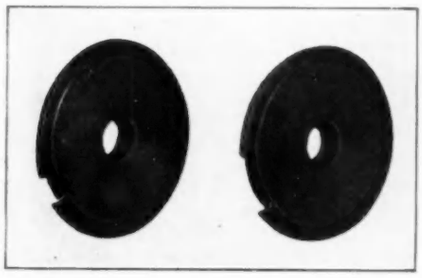


FIG. 5. CUTTING-OFF TOOL BEFORE AND AFTER USING IN THE CHAIN-DRIVEN MACHINE

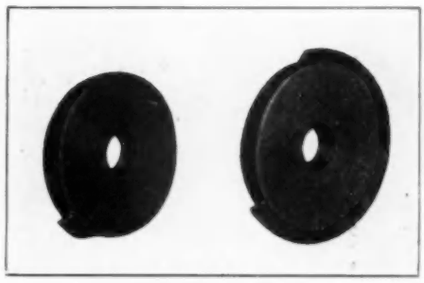


FIG. 6. THE CUTTING-OFF TOOLS USED IN THE BELT-DRIVEN MACHINE

of circumference ground away during the cutting off of 3074 rollers in the 138 hours trial. The amount actually used was only ½ inch, the available length on the circumference which could have been used being 8 inches.

In the belt-driven machine operated for the same length of time in the production of 2485 rollers, the two tools in Fig. 6 were used. That is, one tool was completely used up and about 2½ inches of circumference on the second tool ground away, the total length of cutting edge used being about 10½ inches. Obviously, on the chain-driven machine, very little grinding of the tool was required in sharpening it, while in the belt-driven machine pieces were broken out of the rim of the tool and lengths of ¼ to ½ inch had frequently to be removed by grinding to bring the cutting edge into condition again.

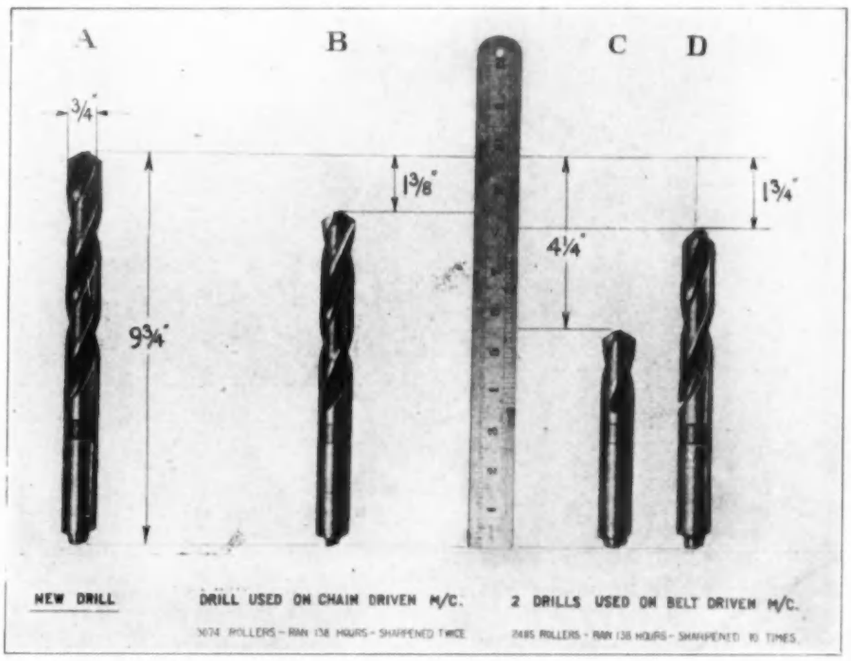


FIG. 4. DRILLS USED ON CHAIN- AND BELT-DRIVEN MACHINES

Speeds and Feeds

The 1-inch stock was driven at a peripheral speed of 125 feet per minute in the belt-driven machine, and the feed of the tool per revolution was 0.0017 inch. In the chain machine the work was driven at a speed of 75 feet and a 0.0027-inch feed employed. As in the case of the drilling operation, the results were unsatisfactory when an attempt was made to cut off on the belt machine at the same speed as on the one with chain drive, and the belt had to be shifted to the next step, giving a speed of 125 feet.

An inspection of the foregoing data will show that during the tests with the two machines, the length of drill used with the spindle and work positively and steadily driven by chain was only 23 per cent. of the length worn away on the belt-driven machine, while the length of cutting-off tool actually used was less than 5 per cent. of that on the machine with belt drive.

Some Advantages

In view of the figures given it will hardly be necessary to enlarge upon the advantages derived from this method of driving as applied at the Hans Renold works. The lengthened life of the tools, the saving of time due to less frequent grinding, and the consequent ability of the operator to attend to more machines, each of them turning out more work and a better product are features which should excite interest in this application of the silent chain to the driving of automatic-machine spindles. Another interesting feature, as already suggested, is the ability to handle satisfactorily with the chain drive, larger and heavier work than is considered feasible with belt-driven machines of the same size.

Belt Tension and Pressure on Bearings

Some important experiments have been made at the above plant to determine the belt and chain tension and the pressure

on countershaft and spindle bearings, and Fig. 7 illustrates the apparatus utilized for this purpose. A similar arrangement was employed for the chain-drive tests. As will be seen, the countershaft was attached to a horizontal framework, pivoted at one end and resting at the other on a platform scale, the jack shown on the scale table providing a handy means of giving the belt or chain any desired tension. As the countershaft was located at the middle of the pivoted frame, the actual tension on belt or chain was double the weight shown by the scale.

FIG. 7. METHOD OF MEASURING TENSION ON BELT AND PRESSURE ON BEARINGS

When the chain-driven machine was at rest there was, of course, no weight on the spindle as the perpendicular chain fell away from the spindle sprocket; the countershaft sprocket taking the weight of the chain, or 32 pounds. Upon starting up and merely putting into motion the spindle, countershaft and pump, the scale registered 2 pounds, so that the tension in the chain was 4 pounds, which was the pressure added to the countershaft and spindle bearings. When drilling, the pressure on the scales increased from 4 to 15½ pounds when the drill was at its full depth of 1⅛ inches in the work; hence the maximum pressure on the spindle bearings was 15½ × 2 or 31 pounds and on the countershaft bearings 31 + 32 pounds (weight of chain), or a total of 63 pounds. On the belt-driven machine when the tension on the belt was regulated until the most satisfactory results were obtained, the scale registered 115 pounds, indicating a pressure on countershaft and spindle bearings of 230 pounds.

Power Tests

A summary of complete power consumption tests made by the firm shows that in the operation of 11 chain-driven machines producing rollers of the dimensions given, the power taken from the countershaft was 4.21 horsepower, while 11 belt-driven machines on somewhat smaller work required 5.69 horsepower.

Handy Work Tables

By R. W. J. Stewart

Mr. Lundane, the foreman of the pattern and die departments of the Chattanooga Plow Company, has devised some work tables that are so handy that I feel all shops having similar work would do well to copy them. A table like Fig. 1 is used for molding plaster, lead, etc., and never gets the floor dirty, as you will note from its construction. The working center, or table proper, *A* is surrounded by a hopper *B*, and a box *C* is placed on the floor to catch all the sand, or plaster, or other refuse matter produced in any operation performed on the table.

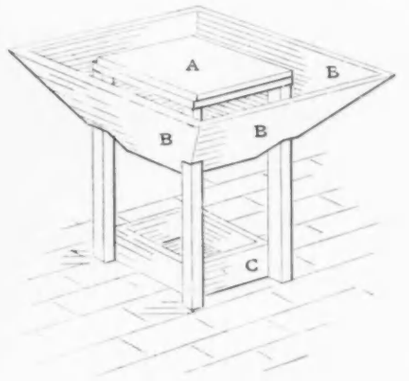


FIG. 1. A NOVEL WORK TABLE

In making large dies for drop-hammers, the plaster is first molded on this table, and later the plaster pattern for the die is cut, shaved, etc., on the same table, or one similar, the chips all going by way of the hopper to the box on the floor.

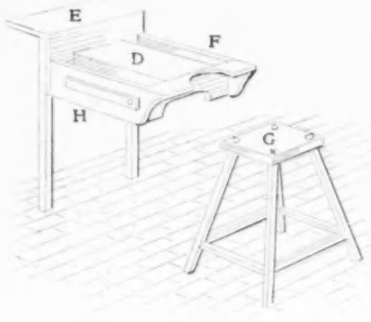


FIG. 2. A DIFFERENT PATTERN

Fig. 2 is another very handy table or work bench, and is designed to be used either as a four-legged table, or as a half table and half lap board. The table top *D* is provided with a cushion made of duck filled with fine loam sand, and for this reason does not break off sharp corners of dies or other patterns. The workman keeps his tools on the shelf *E*, and all

chips, etc., are caught in the trough *F* and another similar trough at the other side of the table. There are two folding legs, one of which is shown at *H*, the other being similar and occupying the same position on the other side of the table.

You will note the leg *H* is pivoted and folded up as though the workman were sitting on the stool *G*, and the table resting in his lap. This table is built very light, and is for small light patterns. If you have work of the kind mentioned you should treat yourself to a rig of the kind shown here.

New Stock Room for Steel

By E. F. Lake

The Standard Tool Company, of Cleveland, Ohio, have recently put up a new building for the better handling of materials in the manufacturing of their drills, taps, milling cutters, chucks and special tools.

STEEL STOCK ROOM OF THE STANDARD TOOL COMPANY, CLEVELAND, OHIO

The ground floor is used for a stock room and the top floor for a hardening room. The stock room is used for the storage of steel, which is received from the mills in bars ranging from 3 to 24 feet in length, and in diameter from 3/16 to 12 inches. This room is two stories in hight and is built to accommodate extra length steel bars, which the company had found more economical to use than the standard, or short-length bars, as there is less accumulation of waste. Each kind of steel is given a series number, as shown by the numbers 62, 65 and 26, which are hanging to division bars in the accompanying illustration. Every bar of steel has its, respective, series number stenciled on it in numerous places before it is placed in the rack, so that no mistake will be made in manufacturing. Each bin or rack is marked in four places with the diametrical size of the steel, the lower set of figures is shown on the angle iron, fastened to the floor, in front of the bins, while the other three are marked in the back at different hights.

The general construction is such as to make the room as nearly indestructible as possible. The floor is made of paving brick laid in concrete and is smooth on top so trucks may be run over it with their loads. An extra-heavy angle iron is bolted to the floor to form the front of the bins and heavy sheet steel is riveted to this and another heavy plate at the back of the bins. Heavy braces are put in to prevent the wall from pushing out or the pillars from being sprung out of shape by the weight of the stock leaning against them. These are shown in the illustration by the pieces running at an angle from the floor near the front of the bins to the walls at the side, or pillars in the center of the room. Other heavy braces are run at an angle of 45 degrees from the floor beams overhead to the outer walls and central pillars.

A statement of railroad statistics for the year 1907 concerning the railways of the United Kingdom shows the following: The authorized capital was $6,784,767,237, of which $6,300,277,963 represented paid up capital. The net receipts for 1907 amounted to $218,379,821. The length of the lines was 23,101 miles, over which was transported 407,710,000 tons of minerals and 108,261,000 tons of merchandise. The passengers conveyed numbered 1,260,117,000, of which 33,355,000 were first-class, 36,697,000 second-class, 1,189,349,000 third-class, and 716,000 were season passengers.

For the handling of heavy stock a steel track is bolted to the floor beams overhead in both gangways and a chain-block hoist is run on this to the different bins or racks in which is stored the heaviest of the steel bars.

The room is made unusually light for a stock room and everything in the room except the floor and stock is painted white to aid in the diffusion of this light. This also aids in keeping it clean. The clean look in the cut was not obtained by giving the room an extra sweeping and brushing for the photographer, as the photograph was taken with the room in its ordinary condition.

A hot-air duct runs the entire length of the room underneath the floor. On top of this duct at stated intervals is located perforated pipes, one of which is shown immediately back of the front pillar in the illustration, and between the two racks of steel which lean against the opposite sides of the pillars.

By sending hot air through this duct, and its perforated pipes, the room is maintained constantly at a certain temperature so that the steel will not be affected by any sudden changes in temperature.

This new building is a part of a general scheme for steel-storage rooms as it is the intention of the company to equip adjoining rooms for different classes of steel and install an industrial railway with ball-bearing turntables and cars to operate between railroad siding and all buildings.

Suggestions on Shop Subjects—Lathe Standards—Single or Multiple Tools

By John R. Godfrey

The advent of some of the new portable engine lathes which have appeared within the last year and are designed to be used in connection with fitting or assembling of work, brings up the question as to whether this is not attacking the problem from the wrong end. The fitting or assembling job was formerly one of the best in the shop and was the last department the apprentice went into before finishing his course of instruction. This was before the days of interchangeable manufacture and a large amount of fitting and other hand work was necessary under the conditions then existing.

Now this has been largely changed, and as an example of the other extreme, I may cite a shop recently visited where the proprietor informed me that he would not have a machinist who was not worth at least $3 per day, as in that case he could depend on his work being made so accurately that it could be assembled by laborers who knew practically nothing of the machinists' trade.

An Apprenticeship System and How It Works

A somewhat similar case is employed in one of the large railroad shops in connection with their apprentice system. In this shop the apprentice boy goes into the erecting department first of all, and is kept here until he secures a good general knowledge of the various parts of locomotives as well as their construction and duty. From here he goes to the various machine departments and learns how to do the different kinds of work. In this case the main object was to hold the boys long enough to become thoroughly interested in the work, and at the same time to prevent them from securing the knowledge and training which would make them valuable in other shops which might try to hire them away after they had learned how to handle a lathe or some other tool.

Both of these instances go to show that in modern shop work there seems to be very little fitting which would call for the use of a lathe or other machine, and it is a question whether it would not be better to call attention to such tools as these for use in repairs, such as roundhouse work in railroad shops, than to be put out as being a tool made to aid in fitting work together during assembling. Perhaps it is only a case of calling a rose by another name, but it appeals to me that it would attract more attention in this way than the other.

Lathe Standards and a Frequent Source of Complaint

Users of high-speed steel tools for lathe work often give voice to the complaint that one of their great troubles comes from the hight of the tool block. This seems to vary anywhere from ¾ to 1½ inches below the centers and greatly affects the shape of tool that can be used in the machine.

Where the tool block is high, it means that the tool point must be kept down, and to get any body of metal under the tool point it must either be hooked below or else a very low tool must be used, which means a very short life between forgings. With a low tool block a good solid tool can be used that will stand many grindings between the forgings.

In addition to the desirability of securing a uniform rating as to the swing of a lathe would it not be well to adopt a standard hight for the tool block so that there could be some uniformity in the shapes of lathe tools for the different machines in the shop?

The question of a standard spindle for each size lathe, as has been suggested, does not appeal to me as being nearly so essential as either the swing or the hight of the tool post. While there may be no objection to having all 14-inch lathes use a standard size thread on the nose of the spindle, its advantages are not apparent in the average shop, although the jobbing shop might find several good reasons for it.

The idea that lathe chucks and fixtures can be successfully interchanged usually disappears after it has been tried on nice work, and we are generally lucky to get a chuck or face plate to run true on the lathe where it belongs without trying to make it a universal tool for all the same size lathes in the shop. If we had a form of spindle nose which resembled some of the precision lathes and insured the face plates going on in the same position twice in succession, there might be more reason for a standard. But even then it is doubtful as to its real value and there are other features which seem more essential in the line of improvement.

Single or Multiple Tools

The milling cutter is often cited as a multiple-point planing tool and in many places we use multiple- or gang-cutting tools instead of the single point of the old days. On the milling machine we use two heads so as to mill two sides of a hexagon at one pass, and in making twist drills we usually find two cutters at work, one in each groove of the drill. Then we get to thinking about all kinds of work in the same way and wondering whether we could do all operations at once, or even take the roughing and finishing cuts at the same time.

Then we go into a shop where multiple tools are almost unknown, where twist drills are made one groove at a time and competing with the others in every way, where hexagons are milled one side at a time at as low a cost as the double-headed machine and other things in a similar way. And we wonder which is right.

Take the case of the hexagon milling and we have a low-cost machine that can admittedly mill one side at least as fast as the other mills two. The setting of the cutter after grinding can be done in half the time the other can be set. We know they are true when the cutter has been around and they may be out with the two cutters unless they are fully set. The interest on the first investment, the floor space and the cost of setting the cutters may offset the additional speed of the double-head machine.

At any rate we know of shops which are running in what seems to be an old-fashioned manner but which seem to compete with and make more money than some of the newer shops with systems that stick out of every window and include everything from blotting paper in the office to the cleaning of the windows in the back shop. And the man who can tell what method is best for his particular case is about as near a success as anyone I know of.

Practical Letters From Our Readers

A Round Table Discussing Details of Modern Machine-shop and Drawing-office Methods, Practice and Economy

WE PAY FOR USEFUL IDEAS

An Unusual Boring Job That Was Too Large for the Lathe

Some time ago we had a traction-engine drive wheel 6 feet in diameter to bore and bush. After considerable study we rigged up the double-spindle lathe shown in the accompanying illustration.

The spindle being hollow, we made a bush to drive in the tail end, boring it to fit a 1 15/16-inch steel shaft. The nose of the spindle had a casting on it with a 1 15/16-inch hole bored in it. A bar was provided, about 10 feet long, with a slot and set-screw in the end to hold the tools. The other end was held in the tool post, as shown. The feed cone was slipped off the end of the spindle. A steel bush was threaded on the outside to fit the chuck and face-plates. This bush was driven on where the feed cone belongs. The large face-plate was then screwed tightly (the steel bush had a set-screw to help hold it). On the large face-plate we bolted 2x8-inch oak pieces to which the traction-engine drive wheel was bolted with hook bolts. The feed cone being off, we had to use the gearing to feed the bar.

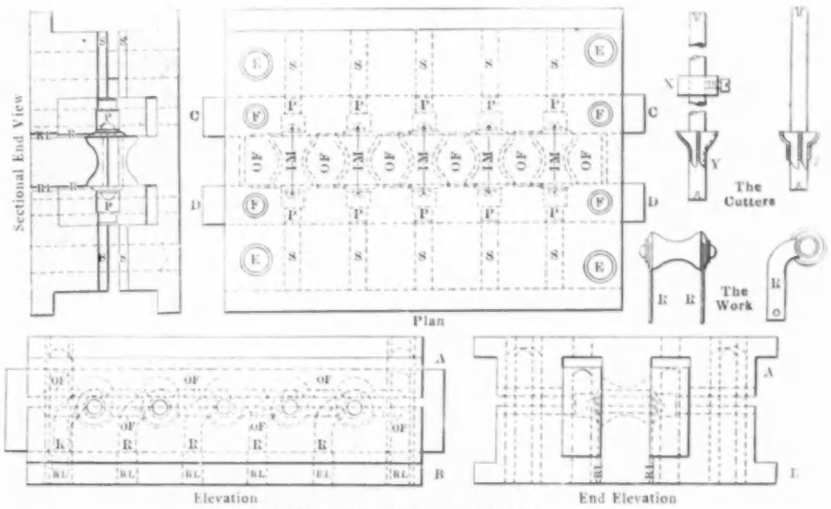
After finishing this job, the next one was a large sheave wheel which weighed a little more than 1400 pounds. Before doing this heavy job we made a rest to come up under the hub of the face-plate to help support the weight. Since these first two jobs, we have had all kinds of wood pulleys of large diameter, and also a few large centrifugal pump castings to bore out.

The lathe has to run backward in order to keep the chuck from unscrewing. The pulley in the picture is only 5 inches in diameter. It is held by a 24-inch chuck.

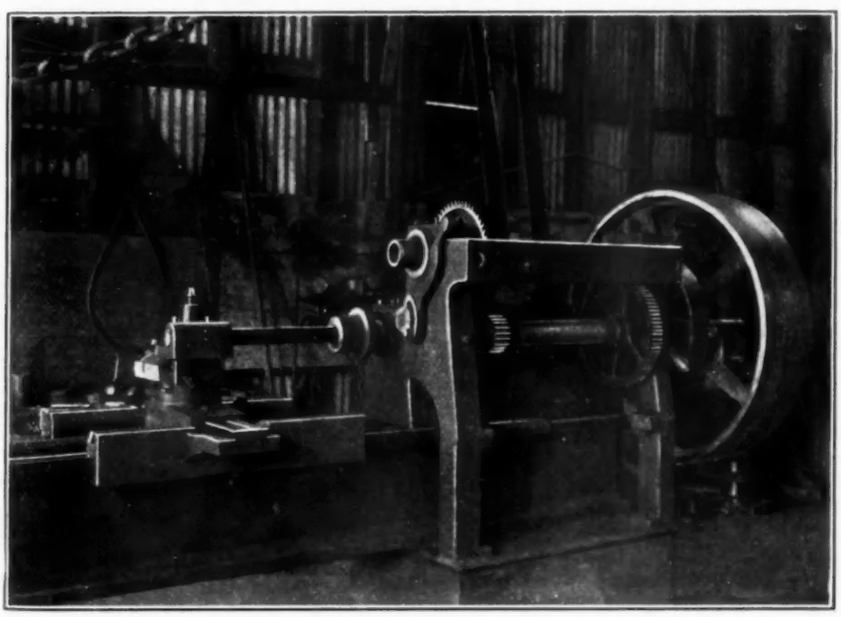
Crowley, La. C. L. HOOKER.

A Mold for Switch Handles

The mold shown in the accompanying drawings was constructed to produce five switch handles with copper blades imbedded in the composition used, and consisted of two plates *A* and *B* and two bars *C* and *D*. *A* and *B* were planed up and the bar slots cut in them so as to admit the finished bars *C* and *D* without any play. *A* and *B* were fastened together with *C* and *D* in their places and dowel pin holes marked *E* and *F* drilled and reamed. *A*, *B*, *C* and *D* were then parted and the holes chamfered to allow easy entrance of the dowel pins which were driven in their respective places. *A* and *B* were then placed alongside of each other on the milling-machine table and after being trued up dead in line with each other fastened down and a semi-circular cutter with a radius 0.003 inch less than 3/16 inch run across them both at the points marked *S*, the depths of the cuts in each plate being 0.1845 inch.



MOLD FOR SWITCH HANDLES



BORING A PULLEY

A, *B*, *C* and *D* were put together, a drill 23/64 inch entered at *S* and run through *C* and *D*. *S* was then reamed with a 3/8-inch reamer, this giving us perfect holes with the centers exactly between *A* and *B*. *C* and *D* are taken out and *A* and *B* separated sufficiently to allow the cutter *Y* to enter, the slot for *C* accommodating all that part of the cutter which is of a larger diameter than *S*. The stem of *Y* is caught in the drill-press chuck and after *A* and *B* are clamped together it is run down until the stop *X* strikes the sides of *A* and *B*. This operation is repeated for all five molds on both sides. Cutter *Z* is then run into the holes on the inner sides of *C* and *D*, the hole being counterbored to the depth shown at the same time so as to give a firm bearing for the buttons marked *P*, which are

now turned up and driven in their places.

The slots for the copper blades *R* are then laid out on *C* and *D* and then milled, extreme care and accuracy being necessary as the slightest crevice noticeable when the blade is in place will cause trouble in operating the mold. *C* and *D* are now placed in *B* and the slots marked *R L* are laid out and drifted in *B*, these being about 0.005 larger all around than those in *C* and *D*. The overflow *O F*, or the space to allow for a surplus amount of composition, is then cut in between the impressions, care being taken not to weaken the edges of the mold while doing this. After this has been done all the different parts of the mold proper *I M* are given an unusually high finish and the mold is then ready to produce switch handles impossible to produce in any other way.

WALTER J. WOODWORTH.

Brooklyn, N. Y.

Drilling an Offset Hole or Offsetting a Drilled Hole

The accompanying sketches show how a knotty problem was solved to the satisfaction of everyone concerned.

A ½-inch by 3-inch piece of round machine steel had to have a 0.225-inch hole through it, following the center line about half way and then offset until one side of the hole was only 1/16 inch from the outside of the piece. About ½ inch was to be the allowed amount of travel for

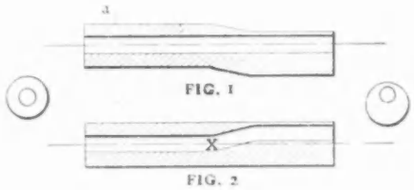


FIG. 1

FIG. 2

THE WORK

the hole to change its position or direction.

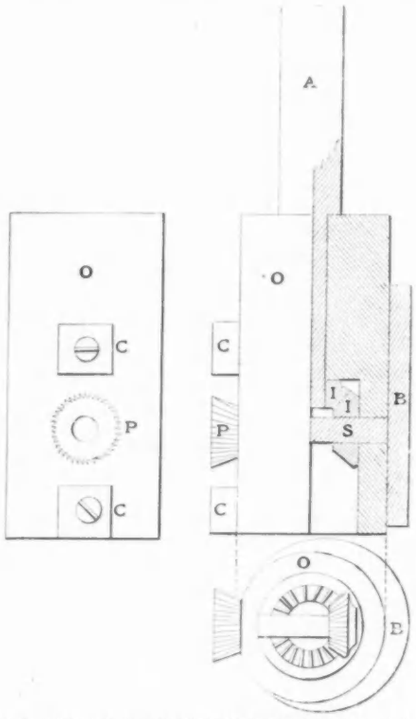
Numerous were the suggestions about making it in two pieces with a threaded joint at *X*, etc., however, a plan was finally hit upon which worked thus:

A straight piece of steel was bent as at Fig. 1, and with part *a* held in the chuck a hole was drilled straight through and reamed, then the piece was carefully bent back straight, care being taken not to let any force act upon the thin part, and the hole was lapped out to the desired size and finish and the piece finished outside.

Ottawa, Canada. W. L. MCLAREN.

Dovetailing in a Drill Press

All who have had experience in fitting keys know how difficult it is to secure perfect uniformity in dovetail slots, or keyways. The tool illustrated here is designed to secure uniformity, and requires but little skill to operate it. The



KEYWAY ATTACHMENT FOR THE DRILL PRESS

line cut shows the complete tool, partly in section, in order that the interior construction may be seen; the body piece *O* contains a spindle *A*, on the lower end of which miter gears impart motion to the spindle *S*, and mill *P*.

Blocks *C C* corresponding in size to the mill being used, are attached to the body *O*, and serve to guide the mill through the wheel. It is obvious that the body *O* must fill the hole through which the mill is to pass, and to suit varying sizes, bushings are provided, of a crescent shape, as shown. These are attached to the body *O* by means of set-screws.

The ordinary drill chuck holds the tool by the spindle *A*, and gives motion to the mill, without turning the body *O*.

The wheel to be milled, previously slotted slightly narrower than the small end of the mill, is placed on the drill-press platen and the tool brought down until the guide piece *C*, enters. The press may now be started and the mill fed through, either by power, or by hand as preferred. There is no need of clamps to hold the wheel, as it has no tendency to turn; the work is thus quickly and accurately done without requiring special skill. This tool was designed and constructed by J. H. Smith, of Chattanooga, Tenn., and is in successful use by the Wheland Machine Works of this place.

Chattanooga, Tenn. J. QUIRK.

Some Draftsman's Kinks

It hardly seems good taste for a toolmaker to offer suggestions to draftsmen, but I have used the devices described here and found them convenient.

Fig. 1 shows a piece of templet stock 1/16 inch thick filed to the shape shown. The steps on the left-hand side are each 1/16 inch high, those on the right are the same except the first and last which are 3/32 and 1/32 respectively. This templet is convenient for drawing parallel lines; the pencil is placed on one of the steps and the templet carried along with it by means of the perpendicular part of the next higher step; a slight downward pressure will keep the lower edge of the templet in contact with the T-square or triangle. The one shown is to draw lines 1/32 inch apart, but, of course, the steps could be varied to suit requirements.

I recently had occasion to enlarge a drawing of a boat from about 8 inches to 48 inches in length. As the lines were nearly irregular curves I was at a loss how to proceed to get a neat job. I finally had a strip of white pine 52 inches long planed down to ⅛x¾ inch, and notched with a saw ⅝ inch deep every half inch of its length as shown in Fig. 2. This made a flexible ruler that would

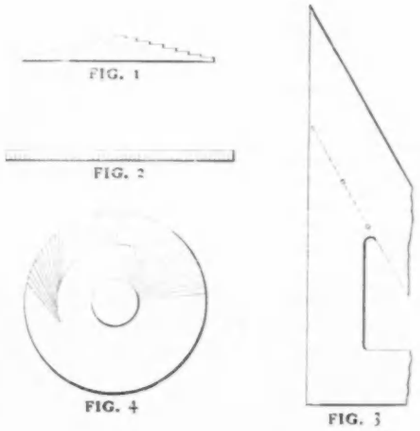


FIG. 1

FIG. 2

FIG. 4

FIG. 3

SOME DRAFTSMAN'S KINKS

readily conform to any curve I needed. Then I took a dozen thumb tacks and caught the heads in a split chuck of the speed lathe and filed the points to a very small diameter; with these I could fasten the ruler to the drawing board in any position required without punching unsightly holes in the paper.

The small holes drilled along the dotted line in Fig. 3 show a convenient addition to a triangle. I use it mostly in drawing radial lines, placing one of my small pointed thumb tacks in one of the holes and using it as a pivot on which to swing the triangle. Fig. 4 shows some of the work done with it.

Troy, N. Y. W. D. COVEY.

A Caliper and a Slotter Bar

There is a combination tool, made by one of the best toolmakers in the country, which is seldom found except in dealers' windows and in the kits of apprentices. Fig. 1 shows the tool as it is made; the catalog says it is a divider, outside caliper, inside caliper and hermaphrodite. Fig. 2 shows how I have changed one and the use I put it to. I have wondered that it has never been put on the market in this form for the benefit of the men who use boring bars. I am sure that anyone who has bored a 4-inch stuffing box with a 3-inch bar will appreciate its true worth. Fig. 3 shows a tool which is also useful to the boring-mill hand, but which he generally has to make for himself. I used it for calipering work on which two finished points could not be had at diametrically opposite points. By calipering from the point of the tool to an opposite point on the finished surface an experienced operator can work close enough to suit the requirements of a large variety of work. If two men each have use for a tool like this they can buy an inside and an outside caliper of the same size and from them make two tools like the one shown.

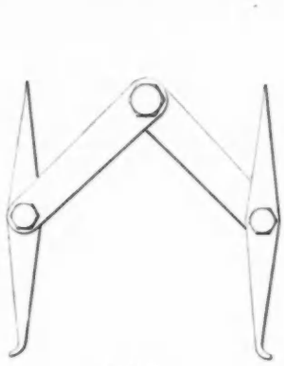


FIG. 1

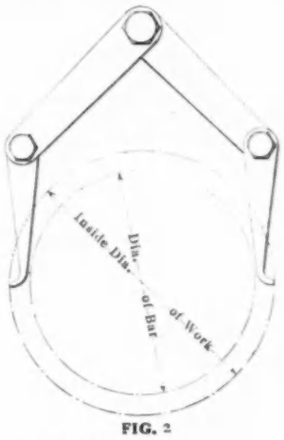


FIG. 2

FIG. 3

A MODIFIED CALIPER

Fig. 4 shows a slotter bar which I once used in a 10-inch Bement slotter, and have never seen its equal. I don't know who deserves the credit for its design, but it was made because the foreman insisted that the tool room furnish a bar that would do away with the old-fashioned wedges for securing the tools, and yet not be too cumbersome to use in the close places which are so common in slotter work. His principal reason for this was that he had himself lost an eye by hitting a steel wedge with a steel hammer. I once saw him, after having seen a horizontal boring-mill hand adjusting his tool with a steel hammer, write an order for a copper hammer and give it to the man, at the same time telling him that should he ever again be found using a steel one for that purpose he would be fired on the spot.

Dallas, Ore. F. W. COLLINS.

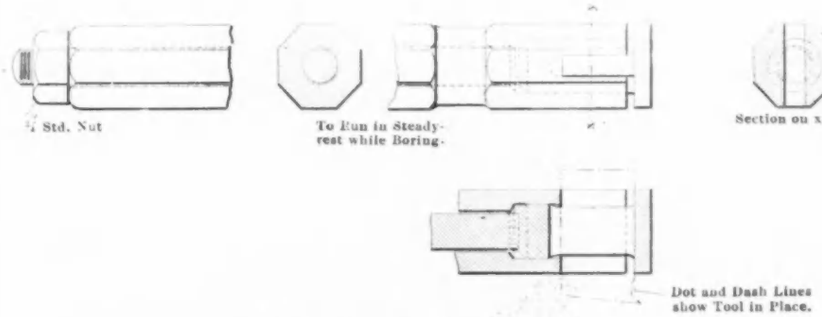
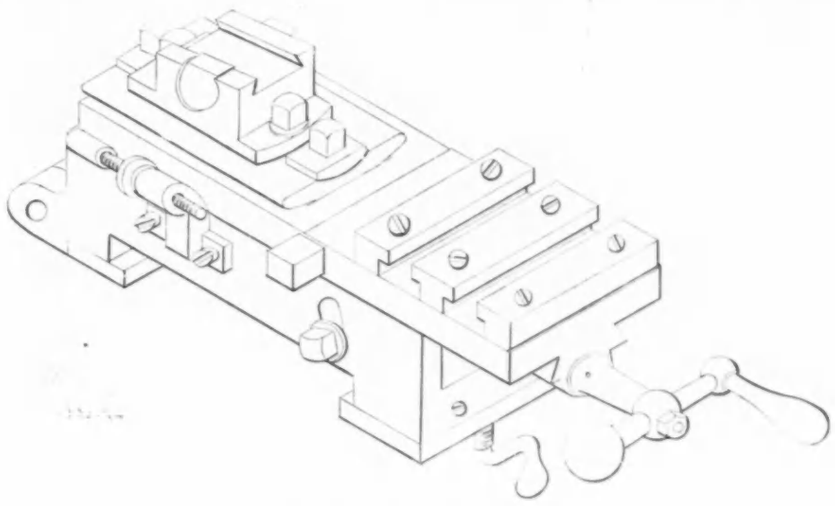


FIG. 4. A CONVENIENT SLOTTER BAR

An Under-cut Forming Slide for the Turret Lathe

The sketch shows a slide, designed and made in the tool room where I am employed, for use on 12-inch Warner & Swasey turret lathes of which we have quite a number. The slide was designed to meet only the requirements of a number of similar pieces made from metal patterns and drawn-brass rod. These parts do not require any adjustment of slide lengthwise of the lathe bed after the proper setting up of the machine is accomplished, therefore no such means is provided for moving the slide as is usually found on attachments of this character.

The slide proper consists of three gray-iron castings machined all over, finished and assembled as shown in the isometric sketch. The T-slots for the front tool post are built up of machine-steel pieces secured to the top of the slide with dowel pins and fillister head screws. The forming-tool holder of machine steel is mounted on a gray-iron plate and secured by two square-head cap-screws, the front one of which passes through an elongated hole in the holder. This provides a means of swiveling the holder to adjust the tool for side clearance when so desired. The plate, which is convex on the bottom side, is seated in a corresponding concave seat bored in the rear end of the slide, and is secured as clearly shown in the sketch; this allows adjustment of the tool to bring the work to correct diameter at the ends.



UNDER-CUT FORMING SLIDE

Should other angle of top clearance for the tool be required than that provided in the tool holder it is obtained by means of the hinged part of the slide which can be elevated by using the crank-handled screw shown underneath the front end of the slide. This also provides a fine adjustment for diameter of work where the

slight change of form due to change of clearance angle can be allowed.

Cleveland, O. B. O. LOOMER.

Replacing a Large Internal Gear

The accompanying half-tones will help to describe an interesting repair job to a pit lathe. The lathe was of about 120-inch swing. The internal gear cast inside the rim of the face plate was giving out. The first operation was to cast the new gear. This was then strapped to the face-plate, turned, faced and bored. Next the straps were placed outside the gear. We left the gear on the face-plate. Next we rigged up a tool carriage to the rear of the face-plate, using a parting tool forged straight with the shank on the left side. We started our cut at the root of the tooth, feeding the tool into the tooth about 1½ inches, then breaking that portion away to give better clearance for the tool. We repeated this until we reached the full width of the tooth. All this time we were using the power furnished by the lathe itself, the driving pinion running in the teeth we were cutting away.

Fig. 1 gives a general idea of the job showing the tool in the lower left-hand corner. This photograph was taken after the teeth had been broken away. We then placed four 10-inch I-beams across the pit, and placed the driving mechanism on these, the pinion meshing into the new gear which we had left strapped to the face-plate. Fig. 2 shows how this was arranged. We next finished the boring on the inside of the face-plate, making the fit. After this we removed the gear, placed the face-plate face down on the floor, made a layout for four ¾-inch feathers on the gear and face-plate. We then slotted and fitted the feathers and assembled the machine and relined and rebabbitted the bearings of the driving mechanism. We used nothing on this job but what you see in the illustrations. The driving gear we used was the one belonging to the lathe. After returning this to its place the machine was as good as new.

Allentown, Penn. GEO. W. RUHF.

FIG. 1. THE OLD INTERNAL GEAR WITH THE TEETH REMOVED

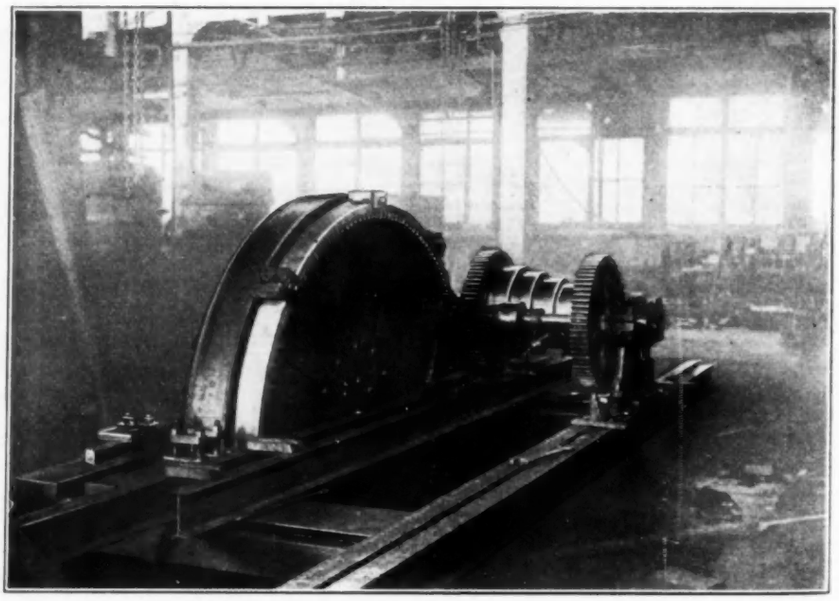
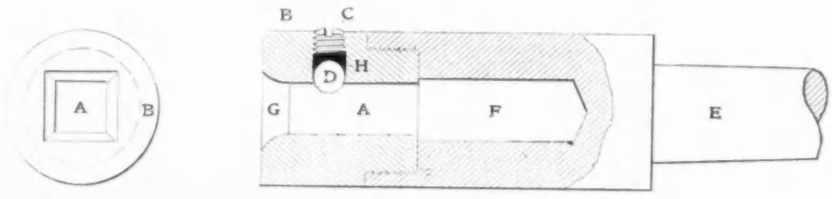


FIG. 2. THE NEW TOOTHED RING BEING USED AS A DRIVER

Tapping Fixture for the Drill Press

We had a very large number of "through" holes to tap and tried various ways until we devised the tap holder shown in the illustration. The body *E* was made of machine steel. It was threaded to receive the tool-steel piece *B* at one end and had a taper shank at the other end to fit the drill-press spindle.



THE TAPPING TOOL

The tool-steel piece had a square hole *A* in it, bell-mouthed at *G*. The tap shanks were squared their entire length a loose fit for the square hole *A*.

The hole *F* in *E* was round and large enough for the square shanks of the taps. A hole *C* was drilled in *B*, care being taken that there was enough of a fin on the end of the hole so that the ball *D* could not drop into the hole *A*. The ball *D* was put in and behind it a piece of rubber or a wire spring *H* and behind these a blind set-screw to prevent their falling out. The drill press was started with the device in the spindle. The tap was easily pushed by hand into the bell-mouthed hole while the spindle was in motion. The spring pressure of the ball *D* was sufficient to keep the tap from falling out but not sufficient to keep it from feeding. For work where it can be used this beats backing out the tap.

New York. E. A. DIXIE.

Grinding Wheels and Bacon Fat

I have a well known universal tool and cutter grinder for grinding face cutters of small diameter using the No. 2 shape alundum wheel, as in Fig. 1. Only a small proportion of the wheel is available for grinding so that we have accumulated a pile of disks 3 inches in diameter and ¼ inch thick. I suggest a hollow cylindrical wheel 3 inches in diameter, 1½ inches wide and ¼ inch thick rim, fitted into a chuck something like Fig. 2, as being more economical. The idea is not new for edge grinding, etc., on larger work and I don't see why it should not be used to advantage on small work as well. By releasing split cone *A* and screwing plate *B* forward by means of a special spanner in holes *C* the wheel is easily adjusted for wear. The chamfer on the No. 2 wheel is not renewed as the wheel wears away, since we do not find it necessary for our purpose.

There is another little matter with regard to grinding wheels which I should like some one of your readers who talk about greasy wheels to throw some light upon. One day a fellow brought in a few tramway rail fish-plates with instructions to have them cut 2 inches shorter. The job looked a bit suspicious at the first inspection. One would have thought that every kind of tool in existence had been used in an unsuccessful attempt to remove a dozen or so cubic inches from the end of one of the plates. I was just about as near beaten as I have ever been when the boss called in and suggested a remedy which turned out quite successful. That was to grind the plates with a wheel kept moist with bacon fat.

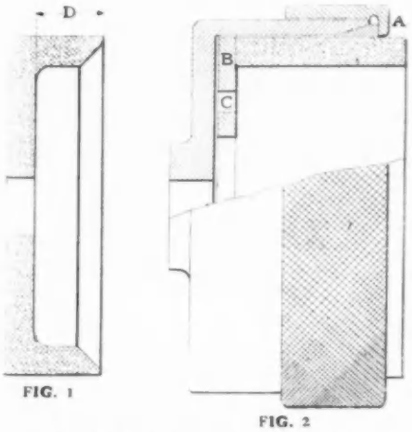


FIG. 1 FIG. 2

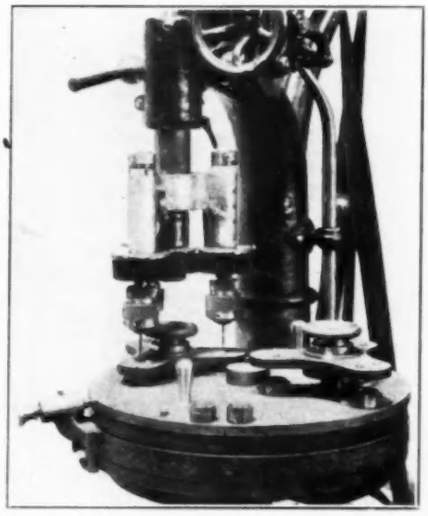
PROPOSED EMERY-WHEEL CHUCK

I have not the least idea why this particular fat should act differently from any other, but the effect of its application was to keep the wheel quite sharp and the grains somewhat loose. The wear on the wheel was frightful, but as the job was urgent and, to the tramway people, almost hopeless they paid up handsomely.

Glasgow. SWAN FIELD.

Home-made Multiple Drilling Attachment

In small manufacturing plants, and even in jobbing shops, it sometimes happens that a lot of drilling is laboriously accomplished by drilling one hole at a time, that could be done at an enormous saving if put on a multiple-spindle drilling machine, but the number of pieces required is not sufficient to justify the purchase of such a drilling machine.



LATHE ATTACHMENT FOR MULTIPLE DRILLING

It is for such an emergency that the multiple-spindle attachment for plain drilling machines, herewith illustrated, is recommended, it being shown in operation. The device is very simple, and can be made in any machine shop. It is merely a light frame attached to the quill, in which run three spindles geared at the lower ends to the central spur gear on the main spindle.

In the illustration these gears are shown without any guard, but in actual use the gears are covered with an aluminum guard to prevent the accidental catching of fingers or clothing in them. On the lower ends of these small spindles are chucks for holding the drills.

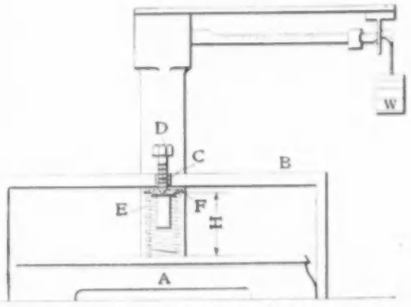
In the example here shown three holes of the same diameter are being drilled, but different sizes may be used, as well as a great variety of positions. Spindles to drive drills of larger size may be geared to the driving pinion with a larger size gear to reduce the speed of the spindle driving the larger drill.

This outfit is used to drill holes in the hubs of small wheels, which are shown lying on the platen. Two jigs are placed on a revolving table, and while the holes are being drilled in the three wheels, the operator sets three other wheels in the other jig and clamps them in position. After the drills have been withdrawn from the first three wheels, the stud, shown at the left of the revolving table, is withdrawn enough to rotate the revolving table and bring the other jig under the drills. The stud is then allowed to engage in the hole, in the side of the revolving table, thus bringing the jig in the proper place for the hardened-steel templets, that guide the drills to the hubs of the wheels to come in exactly the right position. This operation can be continued indefinitely; the details may be varied, as stated above, and the jigs may be on a sliding instead of a revolving table.

Dubuque, Iowa. C. L. BUTLER.

A Fixture for Testing Helical Springs

When designing springs recourse is usually had to tables and handbooks treating upon this subject. After the springs are made and assembled in the mechanism for which they were designed it is often found that they are either too weak or else too strong. In a great many cases it is essential that the spring should be somewhere near the figures established in the drawing room; this is especially true in automobile shops, for valve springs, unless nearly correct, will retard the action of the motor to a greater or less extent. In a number of shops it is customary to make up a large lot of springs at a time, and then the question arises as to some method of testing these springs to see how they come with relation to the drawing. The drawing usually gives the free length, length compressed and the normal length, together with the tension at normal length.



A FIXTURE FOR TESTING HELICAL SPRINGS

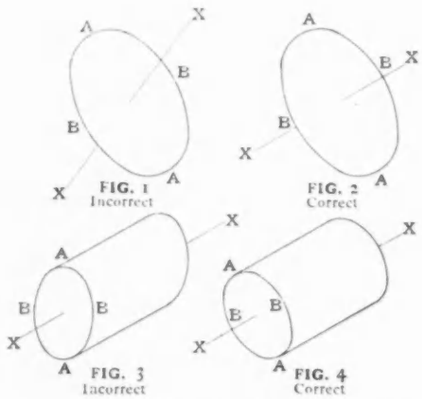
The accompanying sketch shows a method recently used which gave results that were accurate within one pound. An ordinary platform scale is indicated at *A*. *B* is a framework built of wood to carry the bushing *C* and the adjusting screw *D*. The spring *E* to be tested is placed in position and the retaining plate *F*, which has a stud formed upon it to act as a guide, is placed upon it. The framework *A* is then placed so that the screw *D* will bear upon *F*; *D* is then screwed down until the normal length or the length desired *H* is reached, and the scale is then balanced. The reading will then be the

pressure exerted by the spring at that hight.

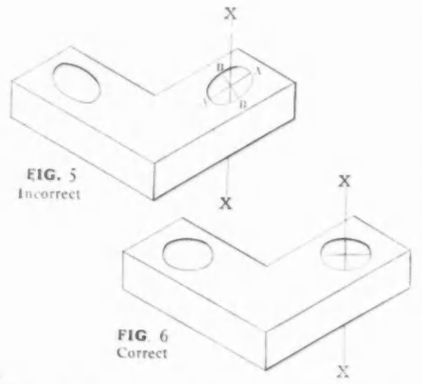
Rochester, N. Y. JOHN COAPMAN.

Incorrect Isometric Drawings

In catalogs, trade-papers and text-books a very common error occurs in pictures of machines and machine parts which show cylindrical pieces and holes. By following a simple rule it is just as easy to make these drawings right as it is to make them wrong.



ISOMETRIC DRAWINGS OF A CIRCLE AND CYLINDER

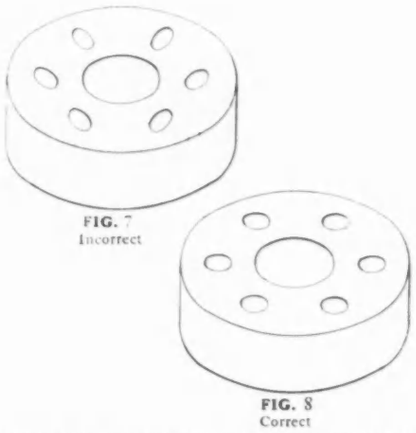


ISOMETRIC DRAWINGS OF ROUND HOLES IN A FLAT PLATE

In the picture of a circle it appears either as a circle, an ellipse or an approximate ellipse. Fig. 1 shows a circle drawn in isometric projection by the approximate method of using four circular arcs. It appears as an ellipse of which $A\,A$ is the major axis and $B\,B$ the minor axis. A line $X\,X$ is drawn in any general position through the center. If Fig. 1 now represents a circle mounted on a shaft which turns there would be a decided wabble to the circle.

In Fig. 2 the shaft $X\,X$ coincides with $B\,B$, the minor axis of the ellipse. Here we get the impression that this circle would run true on its shaft, and it can be proved that this impression is correct.

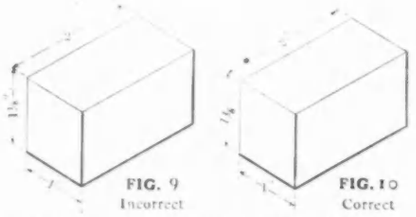
From Fig. 2 may be derived a rule for locating the direction of the major and minor axes of any ellipse which is the picture of a circle. Locate the center of the circle. Draw through this center a line $X\,X$ which represents the center line of the shaft or axis of the circle. The minor axis of the ellipse coincides with $X\,X$ and the major axis is perpendicular to $X\,X$. It is always easy to determine the direction of $X\,X$.



ISOMETRIC DRAWINGS OF A CYLINDER WITH CYLINDRICAL HOLES

Fig. 3 shows a common but incorrect method of representing a right circular cylinder lying on a horizontal plane. Here $X\,X$ is the axis of the cylinder while $B\,B$, the minor axis, is made horizontal. Fig. 4 shows a correct view of this cylinder, in which the minor axis of the ellipse coincides with $X\,X$ the shaft or axis of the cylinder.

Fig. 5 shows a very common mistake. The draftsman seems to reason that the boundary lines of the face in which the hole is drilled must determine the lay of the ellipse and, therefore, he draws the major axis of the ellipse parallel to the longer side of the rectangle in which the ellipse lies. In reality the bounding lines



CORRECT AND INCORRECT DIMENSIONS ON ISOMETRIC DRAWINGS

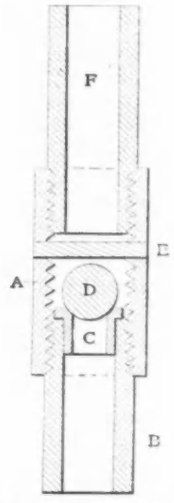
of the face have nothing at all in common with the position of the ellipse. Following this rule, in Fig. 6 $X\,X$ is the axis of the cylindrical hole and $B\,B$ the minor axis should coincide with this. Both holes should have the same appearance. Every circle lying in a horizontal plane should be represented by an ellipse having the minor axis vertical. In Fig. 7 the small holes are incorrectly drawn, while in Fig. 8 they are correctly drawn.

In this connection it is convenient to remember that a circle which lies in any one of the three isometric planes is represented by an ellipse the major axis of which is nearly one and three-fourths times the length of the minor axis. In isometric drawings which are dimensioned the figures are often printed as shown in Fig. 9. If the dimensions are printed so as to appear to lie in the isometric planes as shown in Fig. 10 the resulting drawing has a much neater appearance.

Lawrence, Kansas. GEO. J. HOOD.

A Ball Check Valve for Oil Pumps

Having had a lot of trouble with small centrifugal pumps (fitted to automatic machines) through failing to start up after standing for a few minutes only, I have found the device shown to give complete satisfaction. Fitted on the end of the suction tube in the oil tank is an ordi-



A BALL CHECK VALVE

nary gas socket A. Screwed into this is a short piece of tube B with a ball seat C inserted. About $\frac{1}{8}$ inch above the ball D is a peg E to prevent the ball being sucked into the upper tube F. The idea is clear; the moment the pump is stopped the ball drops on the seat and traps the oil, thus keeping the pump and tubes fully charged. I have fitted this little device to 15 machines and have not had a failure, although some of the pumps were considered worn out. T. A. HUBBALL.

Birmingham, England.

The new Royal Edward dock recently completed at Bristol, England, is a splendid monument of British engineering, substantially and ornately built in every particular. It has a lock 875 feet long and 100 feet wide, and incloses an area of 30 acres with a wharfage length of 3730 feet. It is adjoined by a dry dock 915 feet over all, and 850 feet in blocks in length. This should prove of considerable advantage to Bristol's merchant marine, and will stand as a great engineering feat.

Discussion of the Previous Question

Letters from Our Readers Showing How Many Men of Many Minds Look upon Various Subjects Opened up in Previous Numbers

WE PAY FOR THESE ALSO

The New File

It may be of interest to some of your readers to have the experience of a disinterested party in connection with the new type of file, illustrated and described on page 287, Vol. 31, Part 2.

In the fall of last year I was in Europe, and, among other things, took in the machinery exhibition then being held at Olympia, London, Eng. One of the stalls was occupied by a manufacturer who was exhibiting files similar to those in the cut accompanying the description, and I was induced to step inside and make a practical test of the claimed superiority of the new product. As a result, it seemed to me that the advantages were "level with the claim."

The feeling at first use is curious, as the "cut" has a peculiar sliding effect, and one misses the old familiar "bite" of the orthodox file, but after a short while, when the arm becomes accustomed to the new sensation there is no doubt in the mind of the user as to the efficiency of the tool.

The trial was not confined to any one metal, but extended over steel, cast iron, brass, copper and lead, and in each instance the result was the same—a quick, clean cut—leaving a fine, smooth surface without any evidence of scoring or clogging, which is so especially noticeable when filing copper under ordinary circumstances without a lubricant.

Probably the absence of bite mentioned above will prejudice many file users against the new introduction, but it is after all only a question of familiarity, and I for one am very glad to see that an effort is being made to introduce the file into this country. Regarding the length of life, as compared with the standard article, it is up to the makers to prove their statement, and up to some of our go-ahead shops to give the "freshman" a trial.

Boston, Mass. FREDK. C. HERLAN.

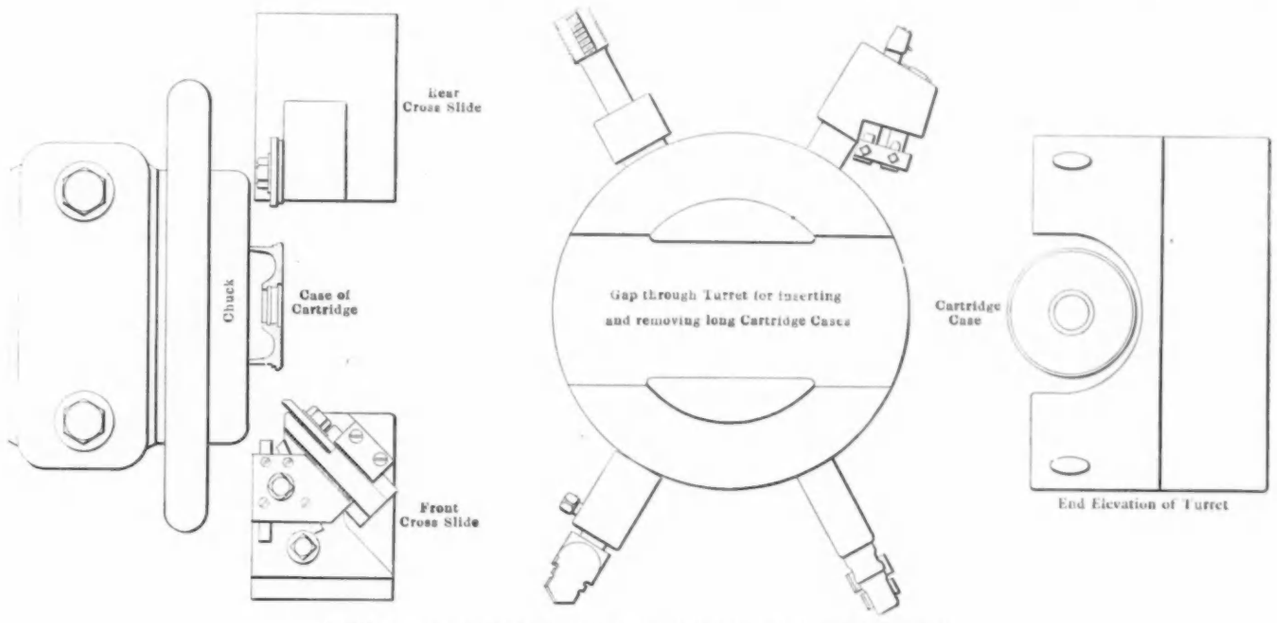
Turning Cartridge Cases

On page 945 has been illustrated and described an ingeniously devised special turret lathe for turning cartridge cases. The difficulties in inserting the long cases into the spindle were overcome by swinging the headstock so that the chuck faced the operator.

The accompanying cuts of a Potter & Johnston automatic show how this problem was solved by this company, and has been in use in several government arsenals for some time.

As will be noticed, a regular six-station turret was used for this work, having a gap cut through it at stations one and four. The machine which completed the work automatically stopped with the turret gap in line with the spindle, thus making it possible to quickly and easily insert and remove the cartridge case from the spindle collet chuck. Other than the gap turret and the collet chuck the machine shown is a standard model.

Pawtucket, R. I. E. B. S.



ANOTHER WAY OF HANDLING CARTRIDGE CASES IN A TURRET LATHE

Do Boys Want to Learn Trades?

Since reading your editorial on page 256 of Vol. 31, and two or three more on the same general topic, it has been my fortune to be engaged in a line of work where I could ask people face to face just what they thought about trades for their own boys. The list of those interviewed has now reached above a thousand, which is a large enough number so that any personal feelings may be safely assumed to be eliminated in the averages. The results show that if the fathers and mothers of young America could have their way more than half the coming generation would learn a trade. This does not imply, of course, that they would all learn the machinist's trade, though, since the inquiries were made in a machine-building town not a thousand miles from Pittsburg, the predominating tendency was toward the machine trades.

One man, and one only, claimed that it was easy to get a boy into a shop to learn a trade. He proved his point to his own satisfaction by challenging me to bring forward any boy that meant business and he would place him in a shop before night. As there is only one boy in the world in whom I possess even a

half interest, and I was afraid the man might succeed, I had to let him win. This same man told me that they were already teaching trades in the schools, which was also new to me. When I pressed him for more explicit details I found that to him, manual training meant a trade. I could not convince him that a boy who had spent a week's time over a wood-turning lathe was not necessarily possessed of a trade. If it were not for possible international complications I might add something about the felicity with which he played tag with his h's, but since he was the only one to raise this point I will let it go.

Now how about the discrepancy? Do American boys want to learn a trade? Would they rather be counter jumpers? These are serious questions and on the answer which our growing generation makes to them depends our future as a manufacturing country. Mind you the favorable answers that I mentioned above were given by the parents, not by the boys themselves. There are three essentials to a boy's learning a trade: First, the boy's desire; second, the parents' consent, and third, the opportunity. Half the boys can have their parents' consent, now how about the boy's desire. A boy of 14 has no desire other than to be a happy, rough, boyish boy. If he goes to school or to work he does it because he has to. If all the other boys in the neighborhood go to school or to work, then it becomes second nature for him to go too. We all know of manufacturing villages where practically all the boys go to work in the mill just as soon as, or just before, the law releases its grip. Ask a boy to stop play in the middle of vacation and come in and study his lesson for the next year. What kind of enthusiasm will you get? Just the same kind you get when you ask a boy to stop going to school and go into a shop. Ask all the boys to go into the shop and they will throw away their books and make a dash for it. Every live boy hates books and loves to create something at some stage in his life. There are enough dead ones to fill the colleges and other receptacles for bookworms. These live boys are bashful and they do not know what they want. You can stampede them as a whole, but as units you cannot budge them with anything less than dynamite. Then again they do not want to learn any one trade. They do not know what a trade means. Only a small fraction of the boys in any community have fathers who are possessed of a trade. The shop doors are not open to them now as they formerly were. They cannot stand at the open door and see a workman "make something" for the simple reason that nowadays it is seldom that an individual wholly makes anything. What these boys need then is the last of the three conditions that I named at first, an opportunity. Not an opportunity to learn some one trade predetermined by a wise parent, or an almost wise teacher; but a chance to find out what the many trades mean till by and by the light dawns upon them that some one trade has for them a greater attraction than any other. Then they need a better chance than is usually given by any shop to master that trade, and they need a certainty that, if they cannot master the particular trade they have selected, that they shall be politely, but firmly, kicked out of it.

So far as I can see there is no possibility of this being brought about by private shops. Private enterprise has all that it can attend to to keep afloat without pretending to give to every applicant the impartial trying out that nearly every boy needs before he can fairly be asked to decide what trade he will follow. Even after he has started to learn some one particular branch it ought to be easy for him to back out and start another and he would be sufficiently familiarized with many trades so that he could make his change intelligently.

I hope none of your readers will say that manual training gives an opportunity for a boy to try out the different trades. Manual training stands in the same light to a trade that the nickel in the slot automatic pistols do to war. It is not even equal to the model husband who was a small imitation of the real thing, for a boy cannot get a correct impression of any trade unless he can see it practiced under commercial conditions.

But to get back where I started. If your readers could have followed me into homes where no hope of sending the boys to college or to a technical school could exist and hear the enthusiasm with which my quest was greeted, no one would have questioned the demand for a chance for the boys in the trades. To be sure there were many who took my quizzing as an impertinence, which it was in a degree, and some who declined to form an opinion, but in nine cases out of ten I found a cheerful desire to discuss the matter, and in very few of these cases did I find any desire to have a boy go into anything other than a trade, or some higher education, if the parents could afford it. There were few, very few, who wished their sons to take up with what have been styled the more genteel persuits. Time and again I have asked what the mothers and sisters would think to have the boy become a greasy mechanic, but not once did I hear the name sneered at.

While my efforts were practically confined to one little spot I am more than convinced that there is a popular wave of favor for the trades sweeping the country, due largely to the underpaid state of the rest of the laboring community. That it will be resistless and that the boom will be overdone, is to my mind just as sure as that the sun will rise tomorrow. Safety lies only in approaching the matter carefully and throwing back every boy who does not give promise of making a workman who will be a credit to his training. There is a place for every one in this broad world and the greatest task of all is to drop every man in his appropriate spot. Men will not do it for themselves for no man can get the right perspective on his own acts and ways. Let us have trade schools under good, honest, conscientious, loving men and we will have one more step toward sorting humanity that will help this old world along wonderfully by reducing the discontent of its most numerous people.

EX-MANUFACTURER.

Worcester, Mass.

Home-made Tools—Boring Cast-iron Bevel Gears

The article by A. J. Baker, on a home-made tapping machine, on page 761, Vol. 31, Part 1, shows that a machine-tool salesman will come across cases occasionally, where the home-made machine of the little man turns out more good work than the product of the up-to-date tool-maker.

I was recently called upon to visit a firm in the Manchester district who make a specialty of boring and turning gray-iron bevel gears as shown in Fig. 1. These gears they supply in thousands to the large textile machinists in Lancashire. They are chiefly 1-inch bore, and the patterns vary slightly in length, from 2½ inches up to 3½ inches. The operation which I was called upon to visit them in reference to, was the boring and reaming. Having such large quantities to do they were naturally anxious to save all the time possible, and to discuss quicker methods should they exist. The way in which they were boring these wheels, and the speed at which they were turning them out was a revelation to me. They may prove of interest to some of the readers of the AMERICAN MACHINIST.

They had three hand lathes, quite 30 years old the manager informed me, arranged along the side of a wall in a row. Fig. 2 shows one of them. They were 8-inch centers and looked only fit for scrap at first sight, but they have completely knocked spots off their former, and supposedly up-to-date, methods of boring these castings. On the main spindle *A* of the fast headstock is sufficient room for a 2-inch belt, which drives onto a 20-inch pulley *B*, which is carried on the shaft *C*. At *D* is a small pulley which drives onto the fast pulley *E* and loose pulley *F* on the barrel screw end, as shown. This serves as an automatic feed for the drill and reamer which are carried in the center hole in place of the center. At *G* is the ordinary hand wheel for operating the barrel. In order to get the two pulleys *E* and *F* on the screw end, it had been necessary to weld a longer end on the latter. At *H*

is a ¾-inch square steel rod, with a belt fork forged on the end as shown and supported in two steel brackets *I* and *J*, which are screwed into the lathe headstock. At *K* is a similar square steel rod, supported by the bracket *L*, which is screwed into the barrel; *M*, *N* and *O* are three adjustable, sliding trip dogs secured by the screws shown on top, to *H* and *K*. At *P* is a ¼-inch round steel stop peg, driven through *H* to prevent the belt fork from shoving the belt off the fast pulley *E* when returned by hand. It will thus be seen that when the lathe is in motion and the pulley *D* driving the pulley *E*, which is keyed on the screw, that the barrel will be fed forward carrying the drill and along with it the rod *K*, which carries the trip dog *O*. This catches against the trip dog *M*, carries along with it the belt fork *H* and thus pulls the belt off the fast pulley *E* onto the loose pulley *F*, as soon as the drill has got through the casting. This stops the feed at once and thus prevents any further damage being done in case the attendant is not near at the time. The drill is withdrawn by the hand wheel *G* in the ordinary way, until the stop peg *P* comes in contact with the stay *I*. Then all is ready for business again. At *Q* is the cored hole in the footstock where the locking cotter for the barrel passes through.

The castings were gripped in three-jawed universal spiral chucks, with special false jaws as shown at *R* in Fig. 1. The space for the teeth is machined wider to facilitate getting work in and out. The castings always accommodate themselves to the front due to the taper on the outside of the teeth.

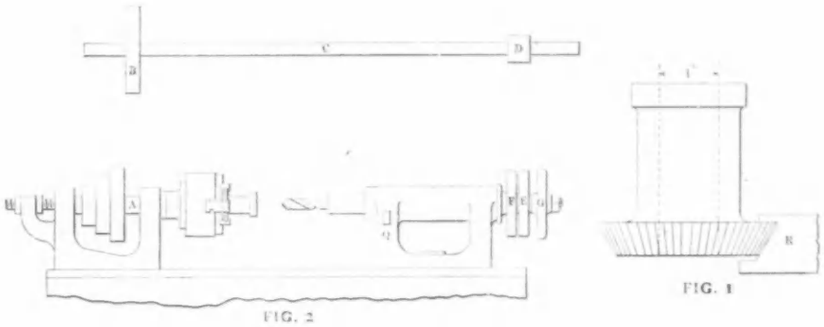


FIG. 2

FIG. 1

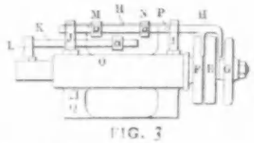


FIG. 3

HOME-MADE TOOLS FOR BORING CAST-IRON BEVEL GEARS

A short, partly worn out, twist drill was run through the castings first, or a three-lip chucking drill in some cases. They are all finished by an adjustable reamer. The drill is changed and reamer substituted by hand. With this primitive device, which did not cost above $100 for the three lathes, a boy at $2.50 per week is boring 350 wheels per day of 10 hours, averaging 35 wheels per hour, and attending to three machines. After watching him for some time I retired and kept my more "up-to-date" plan to myself, as I have yet to see the machine that can beat his performance.

Manchester, England. B. R. ASHE.

"Notes on the Design of Fits for Various Designs of Shafts"

Your correspondent, E. H. Fish, in his article upon the above subject on page 49, does not spare the new student.

Of course one does not expect a new man to come up and take to designing automatic machines naturally, as a duckling takes to water. But I believe that it would be a student possessed of less than ordinary common gumption who perpetrated the example instanced by Mr. Fish.

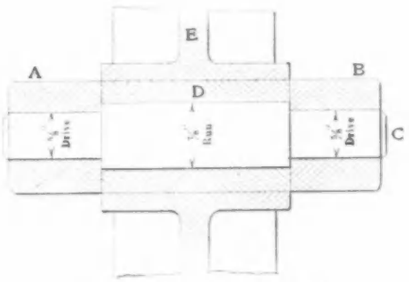


FIG. 1. HARD TO ASSEMBLE

An example of what a supposedly high-class designer can do when put to the test is illustrated in Fig. 1. The machine was to be constructed in Britain to American drawings, according to which, bosses *A* and *B*, which form part of the same casting, have driven into them pin *C*. Upon *C* revolves the bushed gear wheel *E*. Needless to say, the method of assembling is not given. This is one instance—there are hundreds in which men with 10 to 15 years' drafting-room experience have been caught napping. So should we not make plenty of allowance for the raw and much-maligned student?

FITS FOR SHAFTING

The design of fits for shafts is a very interesting subject. Much time and consequently money can be saved to a firm whose designers have a thorough grasp of the principles involved. In looking over old machines one occasionally sees parts bearing on a stepped pin, when the substitution of a pin of uniform diameter would originally have saved money and also have efficiently served the purpose.

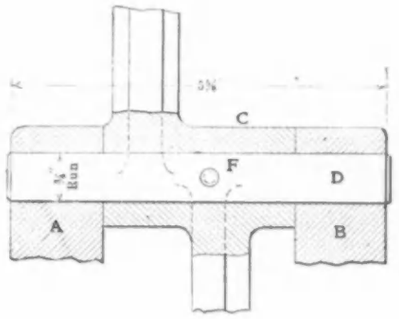


FIG. 3. AS REBUILT

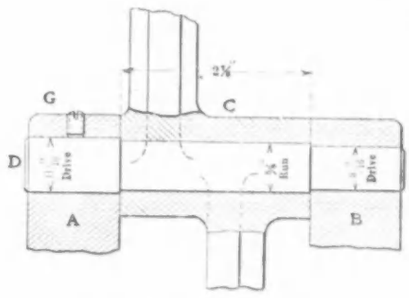


FIG. 2. AS ORIGINALLY BUILT

In re-designing an automatic machine recently I came across the design shown in Fig. 2. *A* and *B* were bosses from the same gray-iron bracket. *C* was a clutch fork of malleable iron which was free to swivel on pin *D*. All holes were reamed to standard sizes shown and the allowances for fits were made on the pin.

The improvements which were effected in these particulars are illustrated in Fig. 3. *C* is now fixed to *D* by means of taper pin *F* and the extremities of *C* (now of uniform diameter) are free to swivel in bosses *A* and *B*.

With this design it is apparent that it is not only possible to produce the parts more cheaply than according to the old design, but we now have a longer bearing surface to withstand any possible canting effect set up by the clutch-fork rollers binding on the sleeve, not shown. The ratio of the over-all lengths of bearings in the two instances cited is practically 2 to 1.

Glasgow. J. H. JOHNSON.

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None sent free regularly, no returns from news companies, no back numbers. Figures are live, net circulation.

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The Basis of Cost

The great activity in improving the methods of machine construction has for its prime object the reduction of cost, by which is meant reduction in wages cost. The cost of an article consists of three items—wages, material and burden—and it is the first of these which has been the subject of attack all along the line. It has been asked of late in a good many quarters if this effort has not gone too far and if, in the search for a reduced wages cost, the item of the cost of the equipment has not been largely lost sight of, and an outgrowth of this comparatively new question is the further one: Should not the aim at the largest possible output per dollar of wages be changed into an aim at the largest possible output per dollar of investment? for, to a considerable extent, the two aims are antagonistic.

Reduction of cost from the output per-dollar-of-wages standpoint involves the use of highly organized and correspondingly expensive equipment, although this is by no means the whole story. Added to the increased cost of such machine tools is the increased cost of their special equipment of fixtures, gages and cutting tools, and apart from this is the further fact that highly organized methods of production commonly involve the making and stocking of parts in large numbers, the cost of which in material and wages, represents an added investment of capital, due to the highly developed methods of production.

At bottom the question is, of course: How much capital can one afford to invest in order to save a given amount in wages cost? a question which has been discussed but little, although it is the most fundamental of all questions connected with factory economy. Little as it has been discussed, the factor of the increased investment growing out of the increased stock of parts has been discussed still less, if at all, although a glance at the stock-room of any modern machine shop will show that it is too important to be neglected.

There is, however, another standpoint from which the matter may be looked at. Profits are figured not on wages, but on invested capital. Profits are made from sales, and in proportion to the volume of sales, and from this point of view it would appear that the volume of product should be measured by its relation to capital invested and not by its relation to the wages paid out.

Assuming a company to be starting in business with a fixed amount of capital, it would certainly seem that this company should purchase its plant with a view to obtaining the largest output per dollar of investment, quite as much as the largest output per dollar of current wages. Against the question: What is to be done if the resulting costs are too high for a profitable business? may be placed the question: What if the opposite policy leads to too small an output for a profitable business? In other words, shall the aim be a large product at comparatively high cost, or a smaller product at lower cost?

The question opens a field of discussion that is well nigh endless, and it is by no means academic. We could name one business of the highest promise in its early days which was practically ruined by the pursuit of the low-cost per-dollar-of-wages idea. It is not easy to say that the opposite policy would have achieved success, although it is perfectly clear that the policy followed was the immediate cause of failure. The goods were made cheaply, beyond a doubt, but the capital invested in equipment was so heavy and the floating capital left over so small, that the business was crippled from the start and nothing has ever come from it. Of course, this introduces another question, namely, the proportion of the capital that should be expended on plants and the portion to be left over for working capital, but nevertheless the fact remains that the pursuit of cheapness as that word is commonly understood, ruined the chances of the business.

It is easier to ask the question than to answer it in a way that will help any one in any particular case; but the fact remains that here is a viewpoint of economy of cost which is of prime importance and to which no appreciable amount of attention has been paid.

The Better Understanding in the Metal Trades

One of the rather peculiar and at the same time extremely gratifying phases of the depression in business circles is the comparatively few failures in the line of machine tools and accessories. There are many shops where neither business nor collections are at all satisfactory, and yet there is a general tendency toward leniency on the part of nearly all creditors instead of demands which might push the small shop to the wall.

The spirit of mutual helpfulness is growing among manufacturers in all lines, due to their getting together in their trade associations, to their becoming better acquainted, and the introduction of the personal element which some have claimed has no place in business. This getting together is largely responsible for the better feeling that is manifest in nearly every quarter, and even though business may not be all that is desired, there is less of the competition that undermines our confidence in humanity at large than ever before.

It is much harder for the average man to take advantage of a competitor if he knows him personally than if he only

knows him as a name, and if he has ever played ball with him at a get-together picnic, it's a pretty mean disposition that can knife a man in the business way.

There never was a time when so much of real fellowship was to be found among machine builders as at present, which bears out the old statement that "our only enemies are the men we don't know." While we can all recall exceptions to this, it is undoubtedly true that feelings of enmity generally die away when we become better acquainted with the other fellow. This is equally true between manufacturers and other manufacturers and between manufacturers and their men. Anything that will make them better acquainted will tend to wipe out serious differences of opinions.

Evening Technical Courses of the Polytechnic Institute of Brooklyn

The College of Engineering of the Polytechnic Institute of Brooklyn, announces for the season of 1908-1909, a series of evening and Saturday courses in engineering, chemistry, physics, mathematics, drawing, history, economics and languages especially designed to afford men in active practice opportunities for professional study. They will be conducted by means of lectures, discussions, reports, problems and examinations, and in every case seek to encourage the expression of the individual and to avoid the impersonality incident to large numbers. The term opens on October 1. No formal examinations for entrance are required except from applicants who desire a degree. The course in mathematics offers the following subjects: Solid geometry, plain and spherical trigonometry, advanced algebra and theory of equations, analytical geometry, differential and integral calculus, differential equations, potential theory and wave motion, analytical mechanics, and least squares.

The course of mechanical engineering offers the following subjects: Mechanical drawing and designing, machine design, steam engineering, license course for engineers, gas-power works engineering, and experimental engineering.

New Publications

HYDRO-ELECTRIC DEVELOPMENT. By Preston Player. 65 4¾x7¼-in. pages; 3 illustrations in the text; indexed. McGraw Publishing Company, New York City. Price, $1 net.

This little work is written for the investor, capitalist and banker, and deals particularly with the commercial side of hydro-electric enterprises. It sets forth the information which should be obtained in order to afford a definite basis for forming a decision as to the merits of any particular water-power scheme. Its treatment is, therefore, entirely from the commercial standpoint, not from the engineering standpoint. There are nine chapters with the following headings: Preliminary Determininations; Methods of Procedure; Engineering Examinations; The Extent of the Market for Energy; Cost of Energy Manufacture; Central Station Economics; Sale of Electric Energy; Primary and Secondary Powers; Capital Costs.

HIGH-SPEED DYNAMO ELECTRIC MACHINERY. By H. M. Hobart and A. G. Ellis. 526 6x9-in. pages; profusely illustrated by 355 diagrams and half-tones; indexed. John Wiley & Sons, New York City. Price, $6 net.

This is a comprehensive treatise on one important phase of the design of electrical machinery and its scope might be correctly characterized as "the influence of the rated speed and output on the design." A knowledge of the detailed steps of the design of electrical machinery is necessary on the part of the reader in order to properly follow the discussions and to grasp the conclusions, as at many points modified processes have been introduced. These are generally empirical in character, but to designers familiar with dynamo electric machinery they should be more useful than the more elementary processes of the average text book. A wide use has been made of analyses of designs, in order to show the influence of the factors of speed and output. This method of treatment should prove most helpful. Three broad facts in regard to electrical-machinery design are stated in the introduction and are well worthy of repetition.

"1. When not carried to excess, the lower the speed in revolutions per minute, the more satisfactory will be the results which may be obtained in designing continuous-current dynamo electric machinery.

"2. When not carried to excess, the higher the speed in revolutions per minute, the more satisfactory will be the results which may be obtained in designing alternating-current dynamo electric machinery.

"3. For a given rated output this preferable speed will be much more for a continuous-current design than for an alternating-current design."

Throughout the element of cost is made prominent. This feature is commendable. The work is divided into three parts. Part I contains Chapters I to IV, inclusive, and deals with matters common to both continuous- and alternating-current machines. Part II, entitled, "Alternating Current Generators," comprises Chapters V to XII, inclusive, and Part III, entitled, "Continuous Current Generators," comprises Chapters XIII to XIX, inclusive. There is an abundance of charts, diagrams, engravings, half-tones and tabular data covering various elements as they are treated, and illustrating current successful practice. As the work is of English origin, European practice predominates. A slight inconsistency in the use of terms appears on pages 60 and 61. On the one, breaking strength and elastic limits are given in terms of tons per square centimeter; on the other, parallel quantities are expressed in tons per square inch. However, a following table (Table XI) has parallel columns; the one, headed "Tons per square inch," and the other, "Tons per square centimeter." The treatise represents an enormous quantity of analytical research and should prove a valuable addition to the working library of the electrical machinery designer.

Personal *

R. D. Day, for a long time connected with the home office of the Mesta Machine Company, has recently been appointed manager of the company's New York office.

William Cairns, formerly superintendent of the General Railway Signal Company, has accepted a position with the Parish & Bingham Company, Cleveland, Ohio, as factory manager.

Max Wieselthaler, connected with the Vienna office of Schuchardt & Schütte, is at present in this country for a short business stay and will make his headquarters at his company's New York office.

H. M. Lucas, of the Lucas Machine Company, Cleveland, Ohio, sailed for Europe on September 5. Mr. Lucas expects to remain abroad some time looking after business interests of his company.

Herbert C. Williamson, sales manager of the Prentice Brothers Company, Worcester, Mass., has just returned from an extended business trip through Europe, his itinerary occupying nine months' time.

W. B. Gardiner, for the past 10 years connected with the Winchester Repeating Arms Company in their model department, has recently associated himself with the W. J. Smith Company, New Haven, Conn. Mr. Gardiner's position will be as superintendent.

Max Ams

Max Ams, president of the Max Ams Machine Company, died at his home in Mount Vernon, N. Y., on September 5. Mr. Ams was a native of Germany, and after settling in this country about 42 years ago he established himself in business, which gradually grew, as a result of his integrity, to its present large proportions. Mr. Ams' specialty was the making of automatic machinery for the manufacturing of cans for various purposes. At the time of his death he was 64 years old, and leaves his business in the hands of his sons.

*Items for this column are solicited.

An Instrument for Drawing Arcs of Any Radius

By J. P. Suverkrop

In the accompanying line cut, Fig. 1 is a plan, Fig. 2 a rear elevation and Fig. 3 a plan showing the instrument set and ready for operation.

Fig. 1, the instrument, consists of the ruling arms *a* and *a'* held against the guides *h* and *h'* by the springs *j* and *j'* fastened by the screws *k* and *k'*; *a* and *a'* are hinged at the clamp screw *b*, which is movable in the slots *m* and *m'*. The pen or pencil point *d* is held in the arm *c*, through which also passes the clamp screw *e* adjustable in the slots *l* and *l'* in the braces *f* and *f'*. In this view the instrument is shown rigidly clamped by the thumb-screws *b*, *g*, *g'* and *c*. The pen or pencil point *d*, the ruling edges of *a* and *a'*, and the guides *h* and *h'*, are in line with each other, thus if the instrument be moved laterally in either direction, the pen or pencil *d* will describe a straight, or right line.

Fig. 2 shows more clearly the clamp screws *g*, *g'*, *c* and the guides *h* and *h'* with the screw points *i* and *i'*. These latter hold the guides *h* and *h'* on the paper, or other material to be drawn upon. Fig. 3 shows the instrument set for drawing a true curve, but is exaggerated to show it more clearly, as the device is primarily intended only to describe curves of greater radius than can be accomplished with the ordinary instruments in use.

The guides *h* and *h'* are set firmly, as shown at the ends of the chord, subtended by the arc intended to be drawn, all the clamp screws being loosened. The pen or pencil *d* is set exactly at the intersection of the radius and the ordinate or rise of the arc to be drawn; then the screw *b* in the slots *m* and *m'* in *a* and *a'* is firmly clamped, and also the screw *e* in the slots *l* and *l'* in the braces of *f* and *f'*, and the screws *g* and *g'* in *a* and *a'*.

It will now be seen that the instrument is rigidly clamped, the clamp screw *b* passing through *a*, *a'* and *c* holds them firmly together, similarly the screw *e* passing through *f*, *f'* and *c*, and the screws *g* and *g'* in *a* and *a'* perform a similar duty.

Now, if the instrument be moved laterally in either direction, the pen or pencil *d* will describe an arc of a true curve, as shown in the drawing.

In a working model, some modifications or additions will suggest themselves, such as supporting screws for the arms *a* and *a'* to keep them level with the pen or pencil *d*. The guides *h* and *h'* should have a thin ruling edge of hard material inserted in them as they are simply leaden weights, this will insure exactness in the work.

The portions of *a* and *a'* carrying the slots *m* and *m'* may be altered by making them separately and fastening them to *a* and *a'*. They might also be made longer and a little further from *d*.

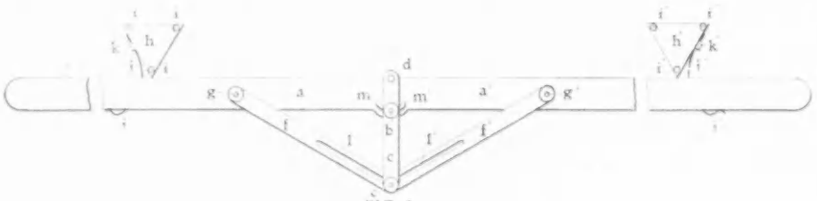

FIG. 1

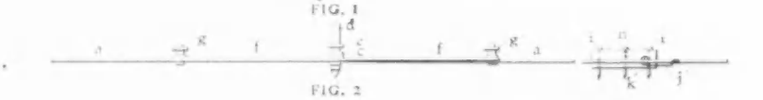

FIG. 2

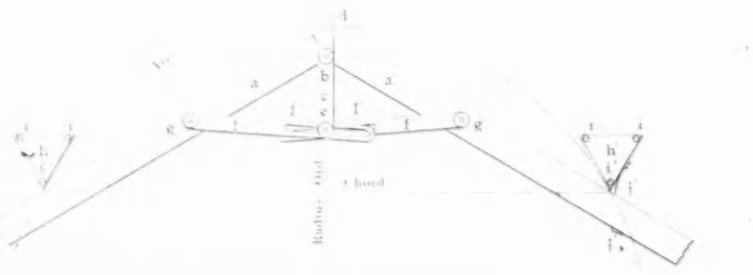

FIG. 3

AN INSTRUMENT FOR DRAWING ARCS

Welding Locomotive Frames

By A. W. McCaslin*

On the Pittsburg & Lake Erie railroad we repair some of the engine frames as many others do at this time, without removing them from the engine. We have

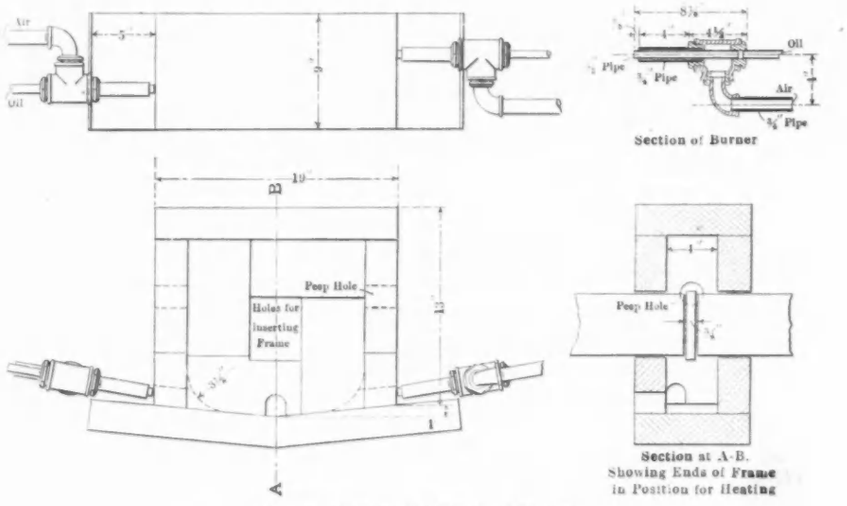

FIG. 1. FRAME WELDING FURNACE

very good results in the heating, as far as appearance of the completed job superficially would indicate, but I do not say that we weld these frames, for I do not consider such an operation made without a lap of some kind deserving the name "weld." In fact, this butting of frames is simply a burlesque on proper welding. I have satisfied myself as to the virtue of this so-called weld by making several in the shop, giving them many advantages that cannot be offered on an engine, and invariably they would separate showing very little resistance, from the light blow crosswise of the weld under a small steam hammer. The breaks would show that a union of the metal had been effected, but would also show a very feeble tenacity. Yet knowing these facts, I am very much in favor of repairing frames this way wherever it is possible to spread the frame and take the heat, as it frequently keeps the engine in service until its time comes for general repairs, and this means quite a saving in money to our companies.

We have what we think, splendid burners, and build a very satisfactory furnace with standard size firebrick. Mr. Shoenberger, foreman blacksmith, in the Fort Wayne shops at Pittsburg, kindly furnished me the original design for both of them. See Fig. 1.

*Paper before the International Railroad Blacksmiths' Association.

I build the furnace with the bottom inclined, as shown in blueprint, making it about 1 inch lower at its center than at the fuel holes at the ends. Have also added a small slag hole at the center near the bottom, so the slag will not gather and be blown up against the frame. We use two burners to this furnace, and crude and carbon oil as fuel, and take a very slow heat. The bottom inclined as mentioned, helps to prevent the wasting of the bottom side of the frame and gives the heat a start to return over the top of the frame and out the peep hole. When the heat is complete the furnace is pushed away into the pit and the work completed with light sledges.

SLIDE V-WELDS

I do not approve of making the side V-weld under a heavy steam hammer without using a channel tool. The "laid-in" piece travels or flows both ways from its center, crosswise of the frame, without interference or resistance, and does not spread enough with its angle to increase the lap or to weld properly against the walls of the V out in the frame. That is, it cannot weld properly while flowing in a direction paralleling the walls of the V in the frame. This piece will travel alone, the bulk of the frame preventing the walls of the V-cavity following. If we cut off the ends of this weld it will appear all right, the drag of the iron being just sufficient to hide the weld. The iron in the piece laid in will not be compact near its ends, neither will the weld near its ends be meshed to a sufficient depth.

This will be entirely different, and is a satisfactory piece of work, if done under a small steam hammer with light blows, or with heavy sledges. In this case the laid-in piece should be properly made, and the overhang not cut too close to the frame. The side heats should be drawn well up to the point of the V-piece, and this stock driven back into the weld and at the same time form a lap where it is so much needed, that is at the ends of this weld on top and bottom of the frame back.

If the side V-weld is made in a frame under a heavy steam hammer there should be a heavy channel tool placed on top. This tool should be 8 inches wide, cut out 2½ inches deep, ½ inch longer in the crown, and ¾ inch longer at the mouth than the cross-section of the frame, that it may release readily. It will shear off the extra stock, prevent the laid-in piece from lengthening endwise, will drive it back into the weld, force it against the walls of the V and lengthen the lap lengthwise the frame. Then take a second heat on the laps and there will be no hole or opening at the points of this weld. This is not only the most convenient weld to make in repairing frames, but it is the best.

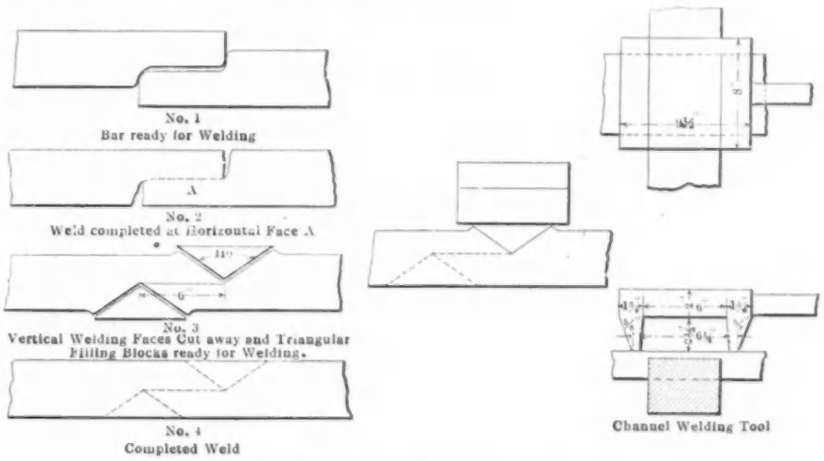

FIG. 2. METHOD OF WELDING RECTANGULAR BARS

We sometimes make in the front sections of frames and in large hammer piston rods, what we call a lap and V-weld. We flatten the end of each piece nearly one third, make the lap and weld as shown in Fig. 2, then drive back the end of the laps and lay in a V. This insures a solid center and a solid side opposite each V, which throws the laid-in pieces about 6 inches apart. This weld will elongate evenly when being reduced and will not slip or shear as the ordinary lap or V-weld will.

Business Items

Modern Machinery Company, Wilmington, Del., has completed an addition to its machine shop, this to be used as an erecting floor.

The address of the English office of the Massachusetts Saw Works, Chicopee, Mass., has been changed to 31 Bartholomew Close, London, E. C.

Hen. E. Newman & Company, Warsaw, Russia, are establishing a permanent exhibit of American products in a building especially provided for this purpose, acting at the same time as representatives of concerns whose products are shown.

LaMay Machine Works, Rochester, N. Y., will shortly move to a new, up-to-date factory, now in course of erection from plans prepared by R. Byers, a steady increase in orders for special, plain and automatic machinery having made the acquisition of additional space and facilities a necessity. New catalogs of factory appliances, tools, etc., are requested.

Trade Catalogs

Hill Publishing Company, 505 Pearl street, New York. Catalog of scientific books. 176 pages, 6x9 inches, paper.

Boston Gear Works, Norfolk Downs, Mass. Catalog E-2 of gears with numerous tables. Illustrated, 96 pages, 3½x6½ inches.

The Winkley Company, Detroit, Mich. Catalog of oil hole covers, grease cups, etc. Illustrated, 20 pages, 6x8 inches, paper.

Dean Bros. Steam Pump Works, Indianapolis, Ind. Catalog No. 71 of power pumps. Illustrated, 40 pages, 5½x7½ inches, paper.

Nernst Lamp Company, Pittsburg, Penn. Bulletin A, describing Westinghouse-Nernst lamp. Illustrated, 30 pages, 4½x6 inches, paper.

The Browning Engineering Company, Cleveland, Ohio. Bulletin No. 33, describing Browning steam shovels. Illustrated, 6x9 inches, paper.

Business Opportunities

Plans are being prepared for a new factory building for the Bridgeport (Conn.) Silverware Manufacturing Company.

The Princess Anne (Md.) Milling Company will enlarge plant and install machinery for making crates, baskets, etc.

Macfarlane Bros. Manufacturing Company, Bridgeport, Conn., making silver-plated ware, will erect a three-story factory.

The Link-Belt Company, of Chicago, Ill., will erect a new office building and two foundry buildings at Indianapolis, Ind.

The Watkins Machine Company, Hattiesburg, Miss., will build an addition to plant to take care of repair work on cars.

The enameling plant of the Rundle Manufacturing Company, Milwaukee, Wis., recently destroyed by fire, will be rebuilt.

The Price Pump and Engine Company, of San Francisco, has decided to locate in Sacramento, where a plant will be erected.

The planing mill and boiler house of the Delight (Ark.) Lumber Company, recently burned, are being rebuilt on a larger scale.

The Sibley Machine Tool Company, South Bend, Ind., will build a two-story addition to be used as a molding room and machine shop.

Fire destroyed the sawmill of the Schwing Lumber and Shingle Company, Plaquemine, La., causing a loss of $50,000. It will be rebuilt.

Plans have been completed for two factory buildings at Anderson, Ind., for the Jenney Electric Manufacturing Company, of Indianapolis.

The Wambolt-Brunsweiler Company, brass founders, now at Appleton, Wis., is erecting a factory in Milwaukee, to which place it will move.

The Atlantic Coast Line Railway, will, it is said, erect a roundhouse at Montgomery, Ala. E. B. Pleasants, Wilmington, N. C., chief engineer.

The secretary of the Board of Trade, of Palestine, Texas, is in communication with an Eastern promoter regarding the establishment of a cotton mill.

The Scovill Manufacturing Company, Waterbury, Conn., manufacturer of brass goods, has been granted permits for additions to its several buildings.

It is reported that the Smith & Son Manufacturing Company, of Oklahoma City, will

establish a plant in Tulsa for making road machinery.

Boston capitalists are in communication with the Huntington (Tenn.) Commercial Club, with a view to locating a large cotton mill in that section.

The Vending Showcase Company, Rome, Ga., is said to be contemplating establishing a factory in New Orleans for the manufacture of vending machines.

The Chicago, Cincinnati & Louisville Railroad Company will erect shops at Hammond, Ind., and abandon the ones now at Peru. General offices are Chicago.

It is reported that the Missouri, Kansas & Texas Railway will erect a roundhouse and machine shop at Wagoner, Okla. S. B. Fisher, St. Louis, Mo., chief engineer.

The Rahn-Carpenter Company, of Cincinnati, Ohio, building woodworking machinery, has purchased a site in Richmond, Ind., on which three factory buildings will be erected.

The Kansas City, Mexico & Orient Railroad Company will soon erect roundhouse and shops at Wichita, Kans., for which plans are being prepared by M. P. Paret, chief engineer, Kansas City.

The Southern Cotton Stalk Pulp and Paper Company, Atlanta, Ga., capitalized at $500,000, plans to establish a number of mills for making pulp and paper from cotton stalks. Offices are in the Chandler building.

The Improved Paper and Machine Company, of Nashua, N. H., will erect a plant at Sherbrooke, Que., to be operated as the Sherbrooke Machine Company. The concern builds paper and pulp-making machinery.

The board of regents of the University of Washington, Seattle, has appointed a committee to confer with the United Metal Trades Association in regard to establishing a fully equipped foundry plant at the University.

The Isthmian Canal Commission, Washington, D. C., will receive bids up to 10:30 a.m. October 5, for steel rails, angle bars, chain blocks, frogs, iron, pumps, drills, files, rivets, screws, cotters, nails, staples, saws, tool handles, hammers, punches, pliers, lathe dogs, ladles, oilers, stamping sets, rawhide lacing, leather, shears, hinges, etc., as per Circular No. 466.

The Navy Department, Bureau of Supplies and Accounts, Washington, D. C., will open bids on the following dates: September 22—Hacksaw blades (schedule 325), giant chucks (schedule 324), taps (schedule 325), steel (schedule 323), pipe, seamless drawn tubes (schedule 328); September 29—Valves, steel (schedule 348), brass hose valves (schedule 345); October 6—Dies, punches (schedule 338); October 13—Radial drill, engine lathe, engine screw cutting lathe, grinding machine, punching machine (schedule 332), engraving machine (schedule 334), lathe (schedule 335), chipping hammer, chipping, calking and heading tool, drill (schedule 333); October 20—Grinder, hammer, trimming press, ring and circle shears (schedule 339).

Want Advertisements

Rate 25 cents per line for each insertion. About six words make a line. No advertisements abbreviated. Copy should be sent to reach us not later than Friday for ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded but replies will not be returned. If not forwarded, they will be destroyed without notice. No information given by us regarding any advertiser using box number. Original letters of recommendation or other papers of value should not be inclosed to unknown correspondents. Only bona fide advertisements inserted under this heading. No advertising accepted from any agency, association or individual charging a fee for "registration," or a commission on wages of successful applicants for situations.

Miscellaneous Wants

Caliper list free. E. G. Smith Co., Columbia, Pa.

Small, accurate drill jigs and dies built to order. R. Rosner, Madison, Wis.

Steel case hardened; modern methods. Boston Gear Works, Norfolk Downs, Mass.

We buy or pay royalty for good patented machine or tool. Box 282, AMER. MACHINIST.

Wanted—Orders for brass goods. Castings and finished product. Box 411, AMER. MACH.

Hand power bending tools, labor-saving, money-making. Estep & Dolan, Sandwich, Ill.

Light, fine machinery to order; models and electrical work specialty. E. O. Chase, Newark, N. J.

Machines designed; automatic, special. Practical working drawings. C. W. Pitman, 3519 Frankford Ave., Philadelphia, Pa.

For Rent—Desk room in well known machinery building on Liberty street. Use of stenographer and telephone. Box 461, AM. MA.

Thoroughly equipped machine shop, with power, centrally located on main line of railroad, open to any good business opportunity. Box 456, AMERICAN MACHINIST.

Special machinery accurately built. Screw machine and turret lathe work solicited. Robert J. Emory & Co., Newark, N. J.

Special machinery and duplicate machine parts built to order; tools, jigs and experimental work; complete modern equipment. MacCordy Mfg. Co., Amsterdam, N. Y.

Manufacturing in Canada. Light machinery. Have good shop, low rental, equipment almost new. Good town; good shipping facilities. Would like a proposal. Box 434, AMER. MACH.

A large English firm of machine-tool importers having showrooms and offices in Great Britain, France, Italy and Japan, is wanting good agencies for machine tools of all kinds. Apply Box 189, AMERICAN MACHINIST.

Machinery built to order and by contract; special parts made; gear cutting, automobile and pattern work, punch press and screw machine work, tools, dies, etc. Blair Tool and Machine Works, West and Morris Streets. New York City

Wanted—First-class machine shop in the most rapidly growing city on the Pacific coast; Eugene, home of the State University and hub of the famous Willamette Valley. Address Department M B, Commercial Club, Eugene, Oregon.

Specialty wanted by manufacturing firm in Great Britain. Will either buy English patents right out or work on royalty. Have latest automatic, capstan and press work plant. Send all particulars to Steel & Screw Co., Ltd., Small Heath, Birmingham, England.

Situations Wanted

Classification indicates present address of advertiser, nothing else.

CONNECTICUT

A practical, up-to-date mechanic with a number of years' experience in automatic and special wire forming machinery, A-1 tool and diemaker; can give estimate on tools, knows how to handle help; desires position with concern manufacturing hardwares and novelties. Willing to go anywhere. Box 458, AMERICAN MACHINIST.

ILLINOIS

Situation wanted by all around practical draftsman, 28, reliable and steady. Good on design, system, clear and accurate drawing. Box 465, AMERICAN MACHINIST.

Position as superintendent. Southern city preferred, by man who is thoroughly competent to handle machine shop and foundry on any class of work. Employed at present, but desires to make a change. Box 464, AM. MA.

MASSACHUSETTS

Draftsman and designer, practical mechanic, technical education, wide experience. Box 414, AMERICAN MACHINIST.

Foreman, automatic screw department, desires change. Expert on all makes of machines, designer of cams and tools. Fourteen years' experience. Address "Automatic," AM. MACH.

MISSOURI

A good executive with 10 years' experience in mechanical and electrical lines desires change. Has held present position of chief draftsman for over three years. Will go anywhere. Box 462, AMERICAN MACHINIST.

NEW JERSEY

Machinist foreman, well experienced, wishes position as foreman over all kinds of machine hands. Box 453, AMERICAN MACHINIST.

Position as draftsman by a steady, reliable young man; seven years' shop and drafting experience. Box 454, AMERICAN MACHINIST.

I. C. S. graduate (School of Mechanical Engineering), experienced machinist and toolmaker on general machine and electrical work, wishes position as draftsman. Box 437, AMER. MACH.

NEW YORK

Foreman, practical in building and testing gasolene, kerosene and fuel oil engines, open for engagement. Box 450, AMER. MACHINIST.

Designer, age 31, graduate engineer, 11 years' broad experience fine apparatus, automatic special machinery, fixtures; very good experimental work. Go anywhere. Box 457, AMERICAN MACHINIST.

Draftsman at present employed in the West desires position in Brooklyn or New York about October 1. Experience on presses and special machinery. Technical graduate, shop experience, 32 years of age. Box 455, AM. MA.

Master mechanic, 18 years' experience on interchangeable work, machine tools, watches, sewing machines, guns, bicycles and electrical apparatus; also designer of special machinery. Nine years with present concern. Box 459, AMERICAN MACHINIST.

Mechanical engineer, Stevens (29), Jun. A. S. M. E. Five years' experience in shop work, mill construction, designing special machinery and piping layouts for power plants. Desires suitable position in the East. Address "Factory Engineer," care AMERICAN MACHINIST.

OHIO

Premium or Piece Work—Two young men (past 30), with wide experience as machinists, foremen and rate men—cost reducers—desire position with reliable firm to install or perfect either of the above systems; experienced in establishing both; results guaranteed. Open for engagement after December 1. Box 460, AMERICAN MACHINIST.

PENNSYLVANIA

Expert cost accountant and systematizer desires an executive connection with manufacturing concern. Up-to-date methods and satisfactory results guaranteed. Box 304, AMERICAN MACHINIST.

Help Wanted

Classification indicates present address of advertiser, nothing else.

CANADA

Wanted—Superintendent for a Canadian factory. Company has large government contracts and up-to-date plant. Applicant should be all round machinist and draftsman, familiar with small interchangeable work, having thorough knowledge of punch press work. Large salary to right man. State age, experience and salary wanted, give references, address direct. Sutherland Rifle Sight Co., New Glasgow, N. S., Canada.

ILLINOIS

Wanted—Patternmaker and draftsman. Experienced in gasolene engines. One that has progressive ideas. Full particulars in first letter. Box 424, AMERICAN MACHINIST.

MASSACHUSETTS

Wanted—A designer of small tools and jigs in a factory in western Massachusetts. Box 448, AMERICAN MACHINIST.

Tool designers and detailers wanted at once; good machine tool designers and detailers; none but competent men need apply. Box 451, AMERICAN MACHINIST.

NEW JERSEY

Chief engineer for a well established machinery manufacturing plant having a wide variety of custom work. Only those who state past experience, references, age and salary expected, will be considered. Box 452, AMER. MACH.

NEW YORK

Mechanical draftsman wanted western part of State. Sheet metal working machinery. Shop experience an advantage. Box 463, AMERICAN MACHINIST.

Wanted—Foreman for hand screw machine department, employing about 30 operators on Jones & Lamson and Bardons & Oliver machines. Only a man that has had experience as a foreman and can produce accurate work need apply. Give full particulars in first letter as to age, experience, references and where employed for the past seven years, or no attention will be paid to the application. Address "Foreman," AMERICAN MACHINIST.

FOREIGN

Required specialist for Russia (Baltic provinces) to make the installation and to survey the manufacturing of enamelled cast-iron tanks and other enamelled cast iron articles; also utensils for water conducting. Address letters to: Sub-Lit. R.S.M., care L. & E. Metzl & Co., Morskaja 11., St. Petersburg, Russia.